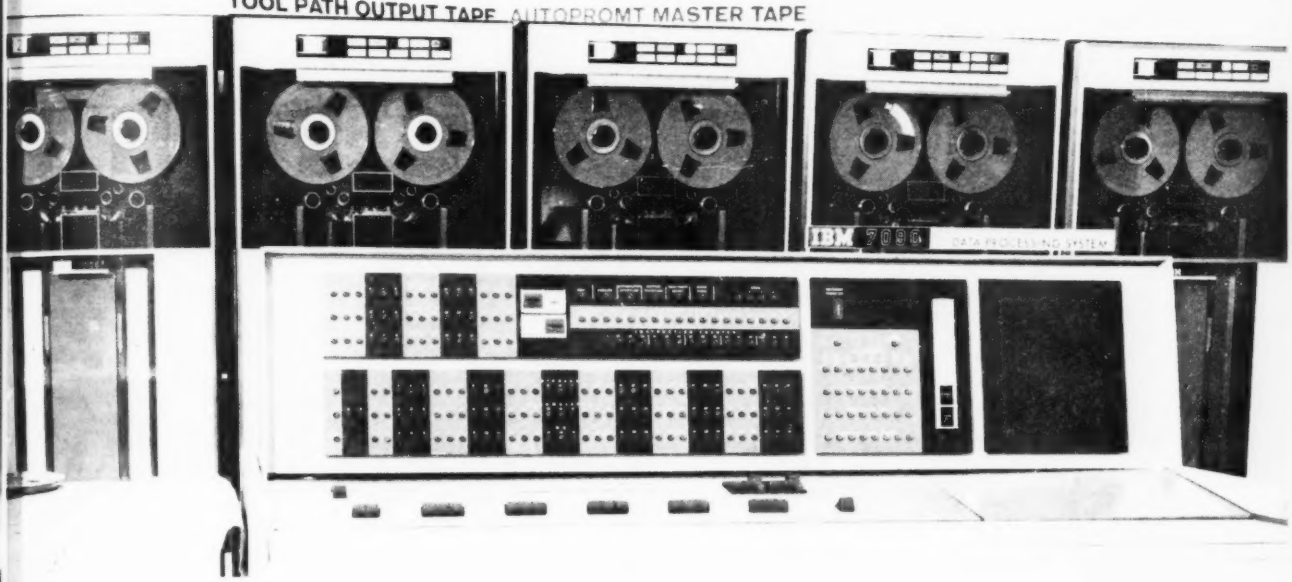
TOOLING & PRODUCTION

AUGUST 1961

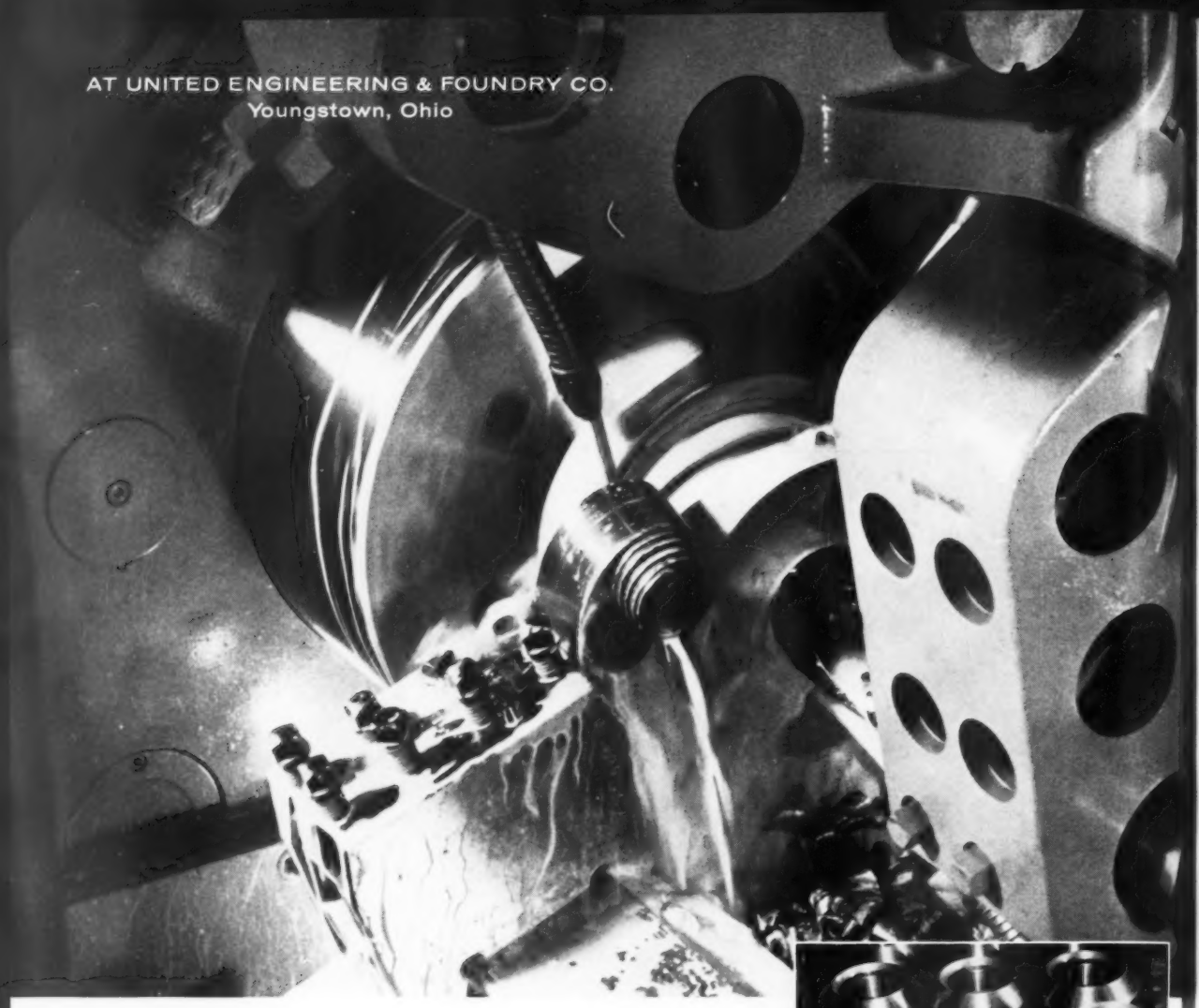


COMPUTER LANGUAGE KEY TO NC BREAKTHROUGH

machining gray iron •

treat surface for longer tool life •

see table of contents inside cover



1″ deep cuts and .001″ tolerances no problem on rugged 3AC Automatic

A Warner & Swasey heavy duty Chucking Automatic outproduces large turret lathe 4 to 1 on 15″ diameter bevel gears

Heavy machine usage is not at all unusual at the Youngstown plant of United Engineering & Foundry Company, a leading producer of mammoth special purpose machinery for the steel and nonferrous metals industries. To cut their costs on work involving heavy stock allowances, close tolerances and small lots, United installed a Warner & Swasey 3AC Chucking Automatic. This machine's proven accuracy, metal removal capacity, fast setup and tooling flexibility ideally met their needs.

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Mitre gears are typical of the heavy metal removal problems at United Engineering. Large stock allowances and tolerances of .001″—often on the same part—place special value on the 3AC's ability to rough and finish in one operation.

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CIRCLE INFORM-A-GRAM KEY NO. 2

TOOLING & PRODUCTION
The Magazine of Metal Working Methods

VOL. 27, NO. 5
AUGUST 1961

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Vol. 27, No. 5 George J. Huebner, Founder 1885-1956

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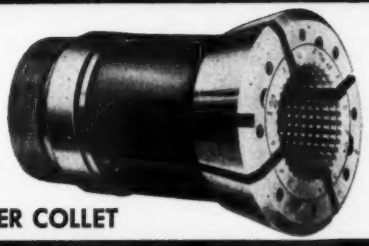

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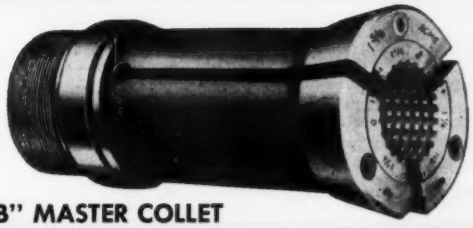

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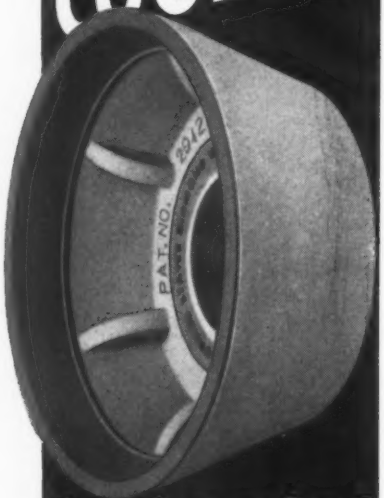

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CIRCLE INFORM-A-GRAM KEY NO. 4

personally speaking...

Dear T&P Reader:

Did you ever stop to think, in this super-advanced age of radio astronomy, multi-channel networks, and signals bounced back to us from the surface of the moon, that our highly touted art of communications presents a stumbling block to still greater attainments in science and technology?

You may ask, "How can this be? Doesn't our advanced state of communications go hand-in-hand with today's science and technology?" Sure it does, but I still think I can make a case.

Communications is a two-way street. Over all these years of search and research we have added immediately—and I mean, literally, immeasurably—to our store of knowledge. And where have we stored it? Here, there, and everywhere!

Thus we are faced with the very real problem not only of what has gone before, but how to find it, how to get it back! We are mindful of Longfellow's poem: "I shot an arrow into the air, it fell to earth, I know not where." Too much of man's knowledge has gone we know not where—like scatter shot.

We can get much comfort from the manner in which communications and science and technology are bootstrapping themselves out of this dilemma. Vast libraries are being reduced to microfilm and electronic memory systems. The art of information retrieval is in its infancy, but growing by leaps and bounds.

One ultimate already is looming on the horizon: a machine that can scan a page, printed in a foreign language, effect a translation into English phonetics, and record the knowledge so it can be communicated back to the searcher after a retrieval time of milli-seconds.

Particularly, it is stimulating to dwell upon what this means in new products and new jobs!

Cordially yours,

Ray Hubbard

Publisher

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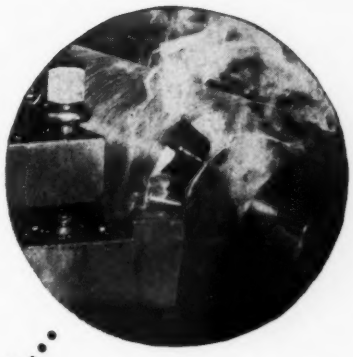

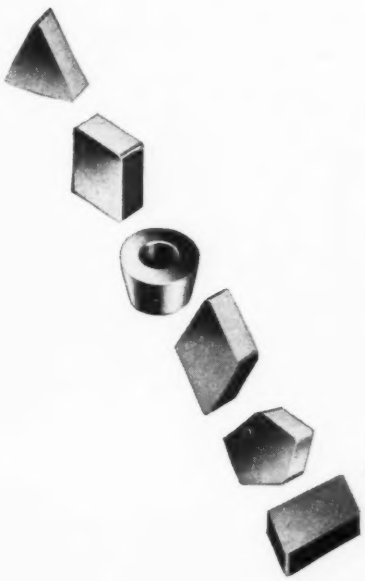

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BURGMASTER MODEL 25AHT
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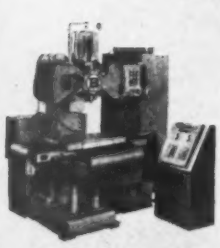
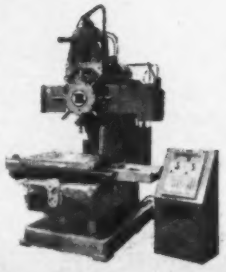
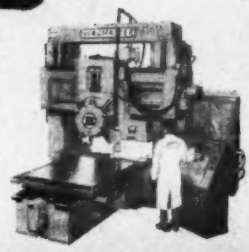


MODEL 2BHT
6-spindle, ¾" capacity in steel. Table travel 10 x 18, 15 x 26, 20 x 30.



MODEL 3BHT
8-spindle, 1½" capacity in steel. Table travel 20 x 30, 30 x 45.



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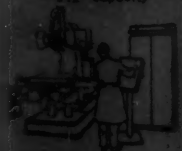

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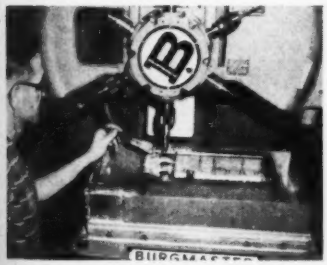
Machining time of the above header board (1" x 2") has been reduced from four hours to 3 minutes by Convair-Astronautics use of a Burgmaster Tape Controlled Turret Drill.



Time of reaming, boring and tapping 90 holes in the above "abort sensor housing" by Convair-Astronautics has been cut from 32 hours to 4 hours by Burgmaster Tape Controlled Turret Drill.

CONVAIR–ASTRONAUTICS has increased production, saved $40,000.00 in man/machine hours and eliminated rejections and scrap. In seven months of operation, approximately 200 different parts, and over 1,000 individual items have been worked on their two Burgmaster Model 2BHT-L Tape Controlled Turret Drills . . . with no rejections due to positional errors. Parts have been both ferrous and non-ferrous, both cast and forged.

Part size range from a tiny header board (1" x 2") with twenty holes center drilled, drilled and reamed to close tolerances. On one side of the board, the small holes are countersunk. Burgmaster Tape Controlled Turret Drills have reduced time on this part from 4 hours to 3 minutes.

To an (18" x 20") abort sensor housing with 90 holes of various sizes reamed, bored and tapped. Burgmaster Tape Controlled Turret Drills have cut the time on this part from 32 to 4 hours, or a man/machine savings per part of $300.00.

At Convair–Astronautics, Burgmaster Tape Controlled Turret Drills save many dollars in tool design, tool manufacture, and in the cost of re-work due to engineering changes.

Human element error is reduced appreciably resulting in further savings on inspection, rejections, scrap and lead time to get into production.

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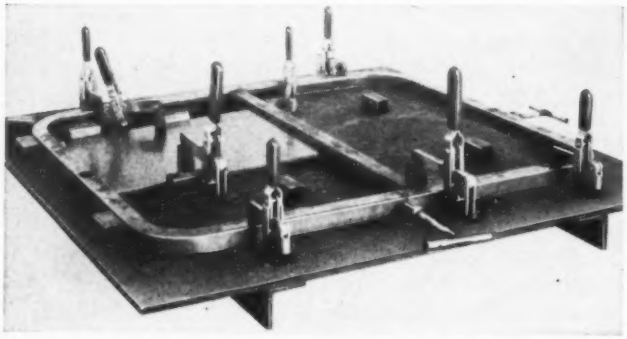

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Talk of the Month

New Generation Dawn For Numerical Control

by Gen. Orval R. Cook, USAF (Ret.)

This presentation was excerpted from a talk given by Gen. Cook, president of the Aerospace Industries Assn. of America, Inc., at the recent IBM press conference introducing "Autopromt." See a related article, "Computer Language is Key to NC Breakthrough," elsewhere in this issue.

AUTOPROMT AND A-P-T—our own (AIA) Automatically Programmed Tool System—have a common base. Through liaison furnished by another member company—United Aircraft—the two systems have been developed as parallel projects. When the current phase of APT development is completed next December, it will contain all the Autopromt listings. Integration of the two systems is planned as a later part of the AIA program.

The Aerospace Industries Association's APT program is a unique effort in industrial cooperation. In the San Diego Convair plant, 20 companies are contributing their top talent to develop manufacturing techniques that could revolutionize production methods, not only in the aerospace industry, but in other industries both in America and abroad.

Cooperation Breeds Success

Phase III of the APT program, which is now under way and will continue throughout this year, represents a determination — a rather expensive one to the participating companies — to compress into one year a job that under "business as usual" methods would have taken five years or so. The fruits of this enterprise will be made available to all elements of industry, including competitors. The APT program is a classic ex-

... Continued on page 12

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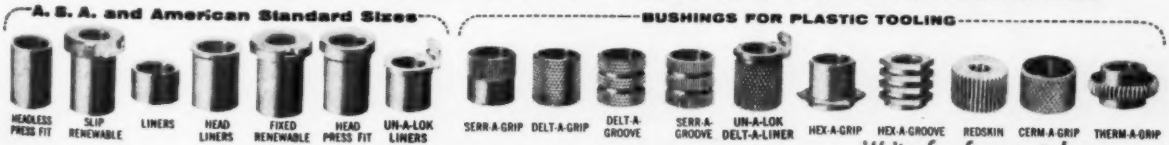

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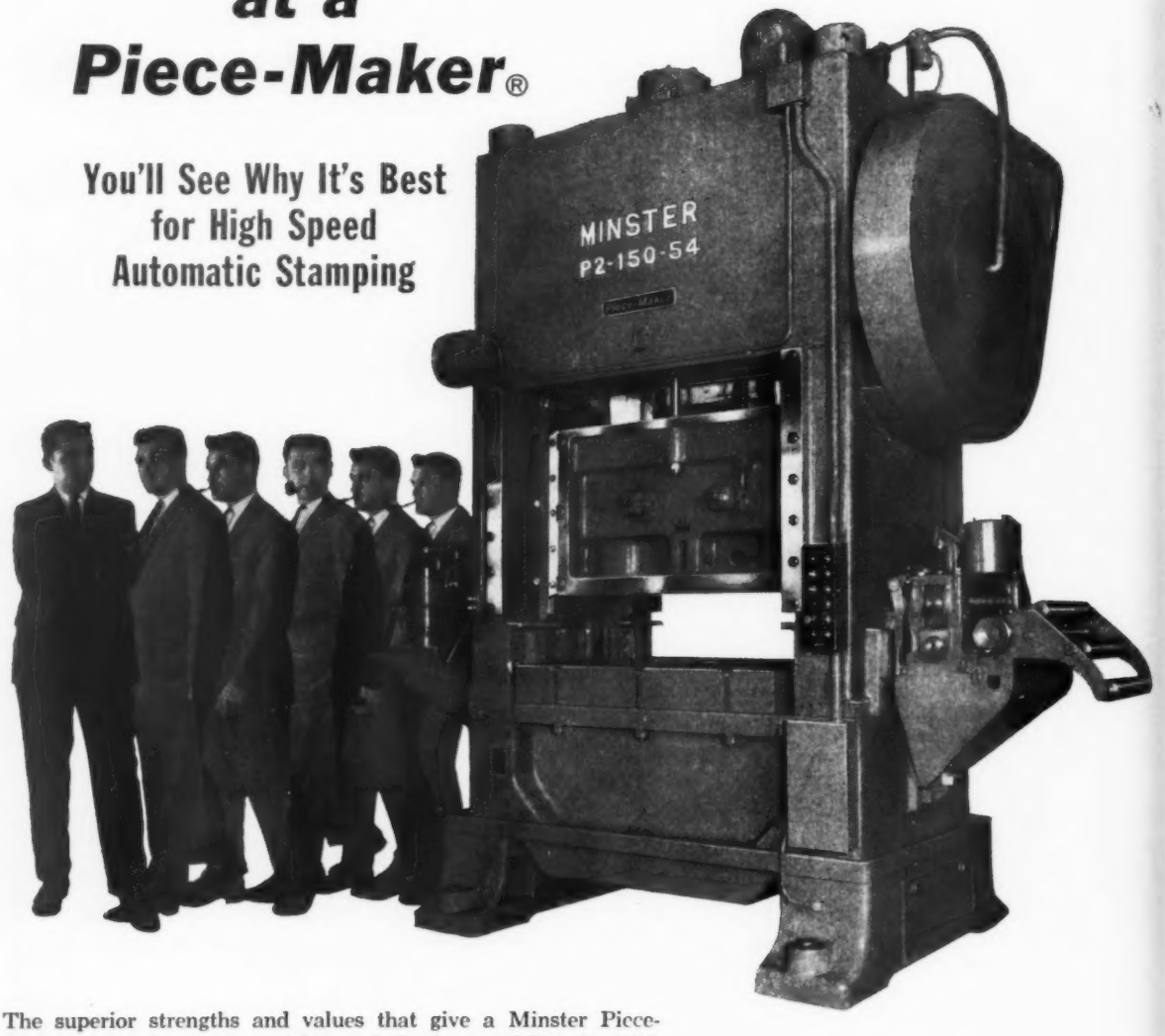

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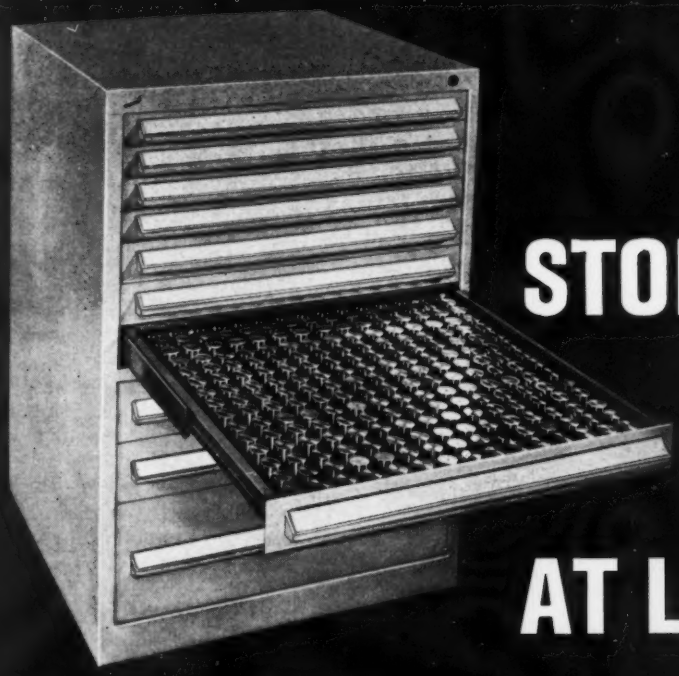

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CIRCLE INFORM-A-GRAM KEY NO 11

. . . Month's Talk from page 8

ample of how competitive companies, working together, can contribute to man's advancement.

While a number of systems are being developed for the control of machine tools, the striking quality of the APT system is that it is universal. When APT III, the current phase of development, is finished in December, the results will be made available to all participants for their use and further development. The system will be adaptable to any type of computer, and should in a short time revolutionize the parts production business.

History of APT

APT got its start a number of years ago when the Air Force's Air Materiel Command asked the Massachusetts Institute of Technology Servomechanisms Laboratory to produce a prototype of a system for preparing tool control data. When basic research was completed, 19 AIA members were called in to construct an industrial version of the system. Findings on this program were released in February 1959, at which time AIA assumed responsibility for the further development and expansion of the system.

Developments which have taken place already defy the imagination. Stripped of their technical terminology, here are some of the more significant ones:

First, the original 100-word vocabulary which is fed into a computer to control the machine tool has now been expanded to 250 words. This allows the computer to speak to the machine tool in complex sentences rather than simple ones, and results in production of more complex parts.

Second, the programming language is being rewritten into a universal computer language called Fortran, so that with modifications, the APT system can be used with any type of computer. The system originally was designed exclusively for use with IBM's 709 computer.

Third, a library of generalized procedures has been developed so that the part programmer no longer needs to repeat involved program procedures each time they are required. He merely refers to the generalized process by name, and the computer does the rest.

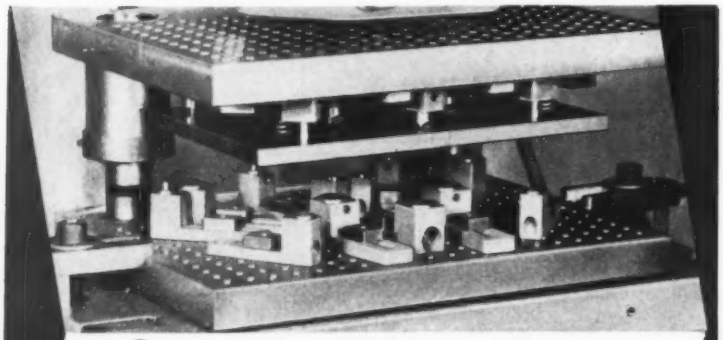
System's Capabilities

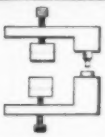
APT is in daily use around the country in the programming of machine tools. It can program three dimensional parts such as a saddle surface—a difficult cut to program because of the involved calculations it requires. Its three dimensional capability will be substantially increased by December.

The great benefit of APT to American industry is its ability to convert a general purpose machine into a special purpose machine. APT will reduce the necessity of acquiring a costly, highly-specialized machine for a limited production run. Merely by a change of program, APT will allow utilization of the same general purpose machine for any number of specialized projects.

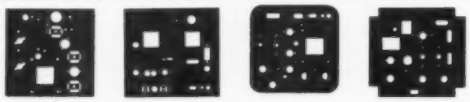
APT's growth potential is virtually unlimited. Our technicians believe that it will someday program parts merely from a designer's concept of what the parts should do. At this point in the program,

. . . Continued on page 15





Punch Multiple Holes in One Operation with REUSABLE DI-ACRO ADJUSTABLE PUNCHES AND DIES



Di-Acro Adjustable Punches and Dies offer you an inexpensive means of rapid tooling for multiple punching of holes of a variety of shapes and sizes. They will do the job in a fraction of the time it would take using a single station punch press and at a fraction of the cost of standard tooling. All tooling can be arranged in a countless number of patterns so that most multiple hole punching jobs can be accomplished in one operation. Tooling can be reused again and again. Holes can be as close together as $\frac{3}{4}$" on centers. A template locates your punches and dies accurately. Di-Acro punches and dies are concentric, readily interchangeable. Standard rounds, squares, rectangles, ovals, D's and other shapes in a variety of sizes are available from stock.

di-acro PRECISION METALWORKING EQUIPMENT

Pronounced die-ack-ro

Di-Acro Adjustable Punch and Die catalog is complete with detailed instructions and prices on all die sets, punches and dies. Consult the yellow pages of your phone book for the name of your nearest Di-Acro Distributor or write us for your free copy.

DI-ACRO CORPORATION
formerly O'Neil-Irwin Mfg. Co. 948 Eighth Ave. Lake City, Minn.

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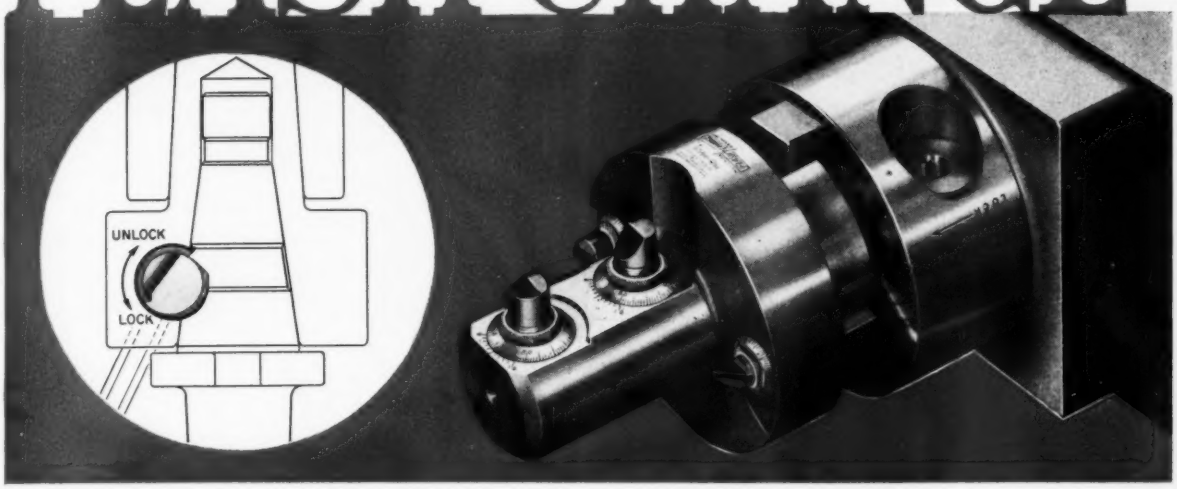
microbore
the precision
cutting tool
system
with

FLASH-CHANGE®



Patented Flash-Change is another exclusive MICROBORE feature. It's DeVlieg's own system of quick change tooling for all makes and types of boring machines, milling machines, turret lathes and automated equipment. The system consists of a Flash-Change tool holder to suit the individual machine spindle and MICROBORE tooling with Flash-Change taper shanks. Clockwise rotation of an eccentric cam in the tool holder locks the cam into an NMTB taper socket in the tool shank. A counter-clockwise motion unlocks and ejects the tool. Tooling is interchangeable from one machine to another or can be reused in the same machine without resetting. Write for complete information on Flash-Change and other developments of the MICROBORE system of precision tooling.

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MICROBORE • PRECISION TOOLING CENTER

DEVLIEG MICROBORE SYSTEM

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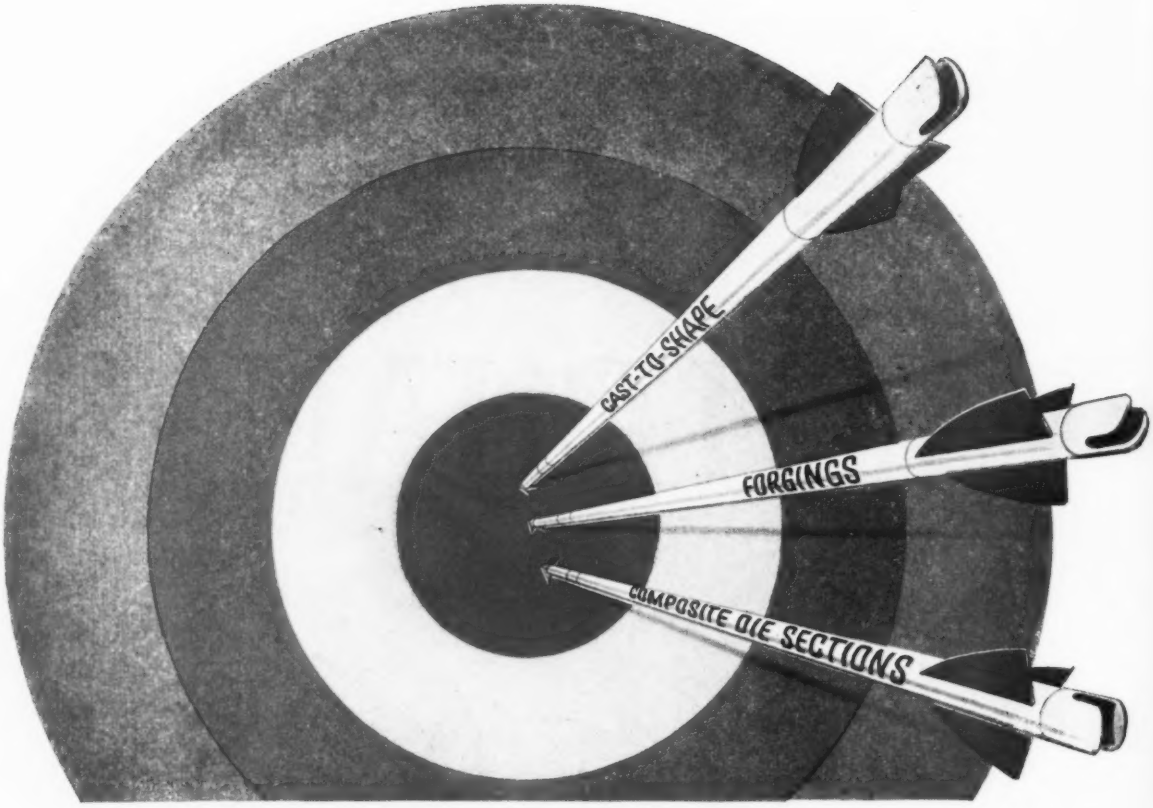

A-L's F&C Division

Always on Target for Tool Steel Specialties

For tool steel in the exact form you need, in the most economical shape for your job—rely on the championship performance of Allegheny Ludlum's Forging and Casting Division. It will help you select the right material for bull's-eye performance every time.

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You get more than one-stop tool steel service from A-L. You get stand-out quality in each part:

√ **A-L's Cast-To-Shape** tool steels are melted in electric furnaces to precise laboratory standards. Exacting foundry practice enables F&C Division to make even very intricate shapes so that little stock need be removed for finish.

√ **A-L's Composite Die Sections** are made of fine A-L tool steel cutting edges electrically butt welded by a special process to nonhardenable steel bases. A wide range of straight and shaped sections is available in a huge array of sizes for any trimming, blanking, and beading die application.

√ **A-L's Smooth Hammered Forgings** come in an extensive range of shapes and in sizes up to 3,000 pounds. You can be sure of quick delivery because all A-L tool steel forgings are made from stocks of over 2½ million pounds of genuine A-L billets stored right on the premises.

For complete information on A-L's tool steel specialties, ask your A-L representative for a copy of the 28-page booklet FC4, or write: ***Forging and Casting Division, Allegheny Ludlum Steel Corporation, Ferndale, Detroit 20,*** *Michigan. Address Dept. TP-8.*

ALLEGHENY LUDLUM
FORGING AND CASTING DIVISION

3289

CIRCLE INFORM-A-GRAM KEY NO. 14

... Month's Talk from page 12

we are like third or fourth graders trying to formulate problems for a Doctor of Science. When we are able to pose more complex design problems, digital computers — through the APT system—will solve them.

Continued Dedication Urged

While we heartily applaud development of such a time-saving system, let me add an admonition. It's man's destiny to control machines, not to create machines which will control him. Lazy reliance upon the marvelous products of our age is no substitute for creative thinking. There will never be a machine or a system produced which can match man's ability to think creatively.

I hope and trust that American industry will bear in mind that APT, Autopromt and similar time-saving systems which will follow, are beneficial only insofar as they free our planners, our creators and our thinkers to devise still greater contributions to benefit mankind. ■

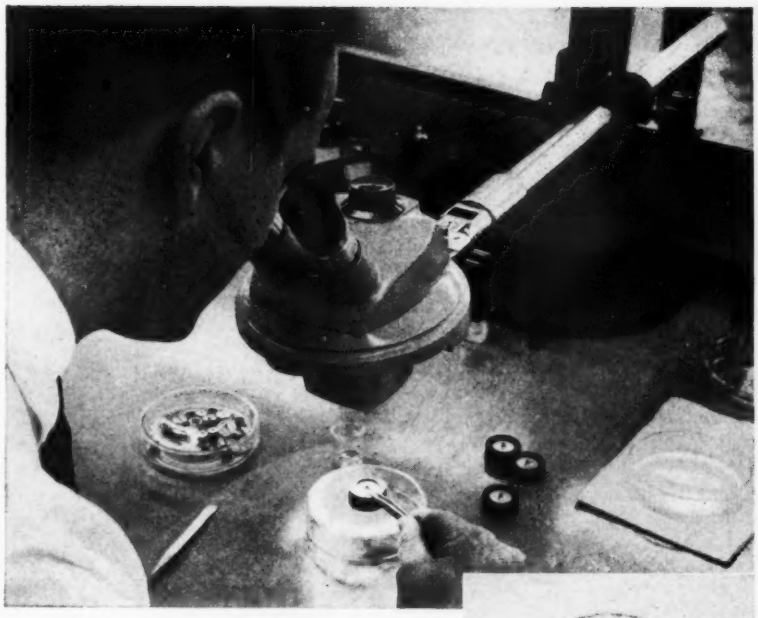
Fluid Dynamics Treated In Handbook

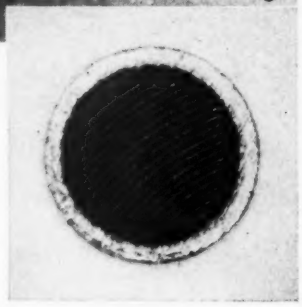
HANDBOOK OF FLUID DYNAMICS, Victor L. Streeter, editor-in-chief. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N.Y., 1961, 1240 pages, $24.00.

More than 30 engineers and scientists—a cross-section from industry, government labs and universities—have contributed to this comprehensive handbook that broadly covers fluid flow principles, theory, methods and allied data.

The book is divided into two parts—the first dealing with fundamental concepts and the second devoted to applied fields. There are authoritative discussions of basic equations in fluid flow, laminar flow, flow with chemical reaction, compressible flow and cavitation.

Recent advances discussed include fluid power transmission and control, magnetohydrodynamics, and computer calculations for fluid flow problems. The author is professor of hydraulics for the University of Michigan's civil engineering department.





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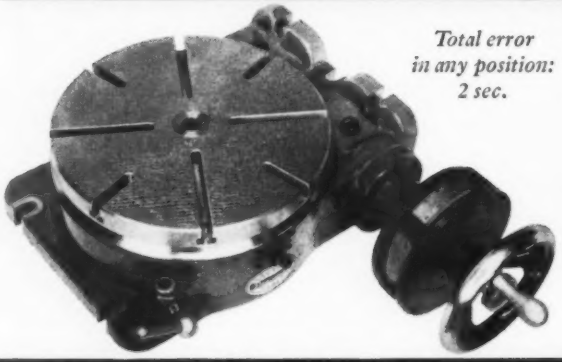
NO. 2 ULTRA-PRECISE TABLE

Reads direct to 1 sec.



Total error in any position: 2 sec.

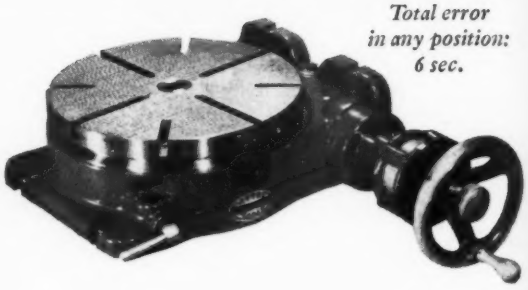
GUARANTEED POSITIONING ACCURACY FOR SHOP USE

All points in 90° increments, from zero to ± 1 sec.
All points in 18° increments, from zero to ± 1½ sec.
All points in 2° increments, from zero to ± 1¾ sec.
Worm accuracy—¼ sec.
Repetition of settings—½ sec.
Total error in any position—2 sec.
2 sec. = 0.00005" (½ tenth) on 10" dia.

Now...with this new No. 2 Moore Ultra-Precise 11-inch 2 sec. Rotary Table—you can provide the closest precision angular spacing needed today. It reads to 1 sec. and has an overall performance accuracy of ± 2 sec. throughout the entire 360°. It is being widely used in angular locations for guidance systems. A nondisengageable, thread-ground worm, combined with the accurately spaced teeth of its mating gear, makes this extreme precision possible. Loss of accuracy, due to repeated throwing in and out of the worm, is eliminated.

NO. 2 PRECISION TABLE

Reads direct to 5 sec.



Total error in any position: 6 sec.

GUARANTEED POSITIONING ACCURACY FOR SHOP USE

All points in 90° increments, from zero, ± 1½ sec.
All points in 18° increments, from zero, ± 2 sec.
All points in 2° increments, from zero, ± 4 sec.
Worm accuracy—2 sec.
Repetition of settings—1 sec.
Total error in any position—6 sec.
6 sec. = .00015" (1½ tenths) on 10" dia.

This popular No. 2 Moore Precision 11-inch Rotary Table has an overall performance accuracy of ± 6 seconds throughout the entire 360°, and reads direct to 5 sec. It is being used successfully by leading companies on government-sponsored precision jobs never before accomplished. You can use this rotary table for countless precision spacing applications on jig borers and jig grinders.

* * *

Write today for descriptive literature about the Moore 2 sec. Ultra-Precise *and 6 sec.* Precision *Rotary Tables.*

Accuracy assured by interferometric inspection and calibration, the first time industry has used light-wave measuring methods for precise division of the circle.

These rotary tables are accurate in either horizontal or vertical position. Further applications are possible by using the table in conjunction with its companion unit, Model No. 2 Sine Plate.

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726 Union Avenue, Bridgeport 7, Connecticut

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A STOCK LEMPCO DIE SET HELPED H. K. METALCRAFT DO THE "IMPOSSIBLE"!

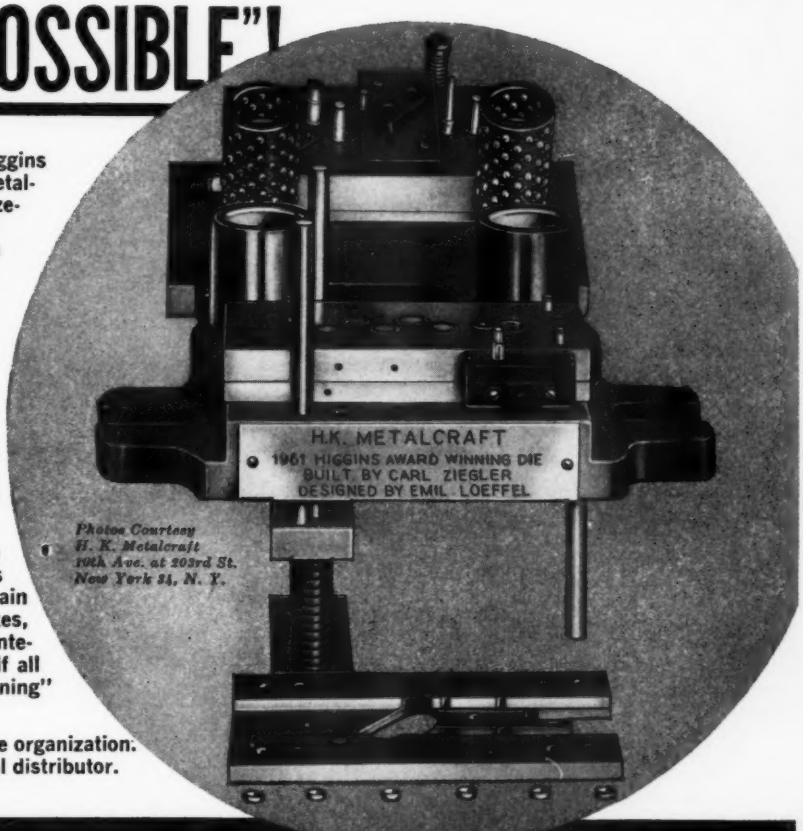
Winner of the John Woodman Higgins Award for 1961, Emil Loeffel, Metalcraft tool engineer, mounted his prize-winning dies in STOCK Lempco Die Sets, assembled to his order by a N. Y. City Lempco Distributor; see photos.

These dies produce, at $1.75 per thousand, a part which formerly cost $12 per thousand.

It was no accident that Lempco Die Sets were selected; Mr. Loeffel says he trusts their accuracy completely and adds, " . . . time saved in assembly and disassembly is very considerable".

Lempco Ball Bearing Precision Die Sets have long been known for this feature and for their ability to maintain exact alignment for millions of strokes, with an absolute minimum of maintenance. Why not find out for yourself all the advantages of using "prize-winning" die sets?

Lempco has a nation-wide warehouse organization. Write for literature and name of local distributor.



Photos Courtesy H. K. Metalcraft 10th Ave. at 203rd St. New York 34, N. Y.

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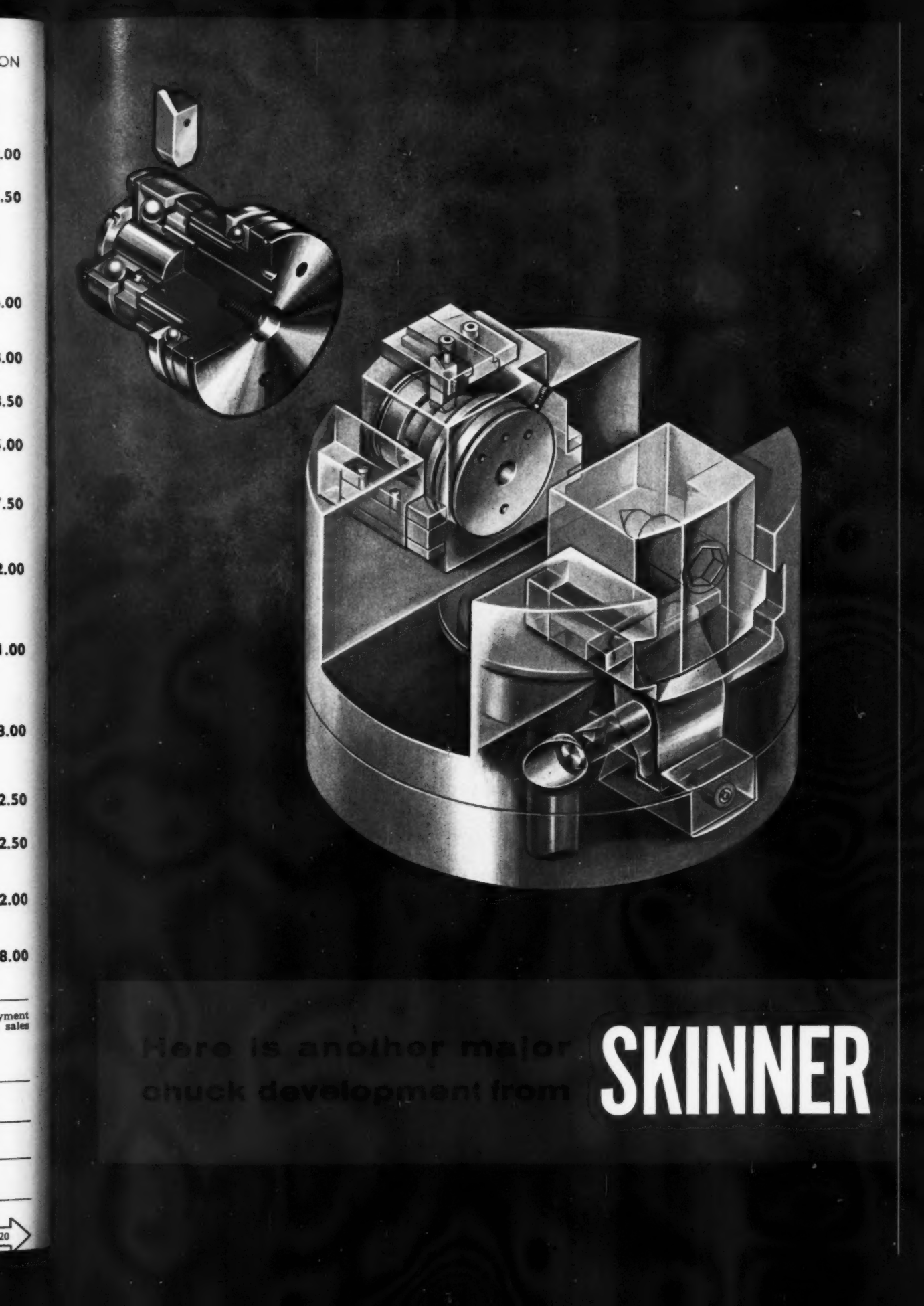
Here is another major
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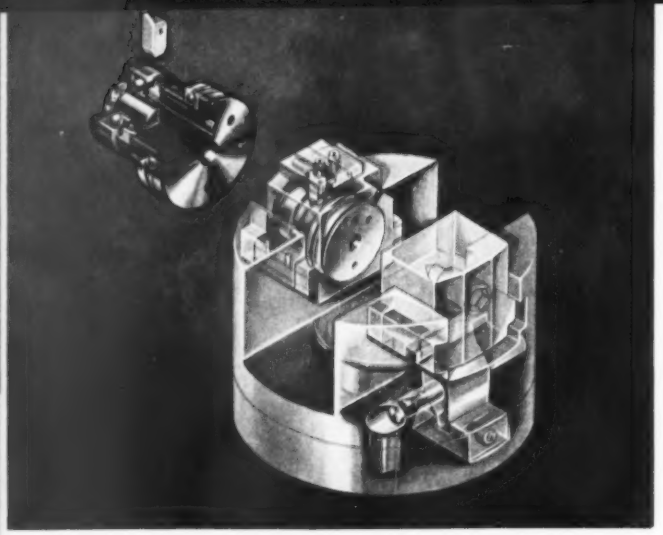
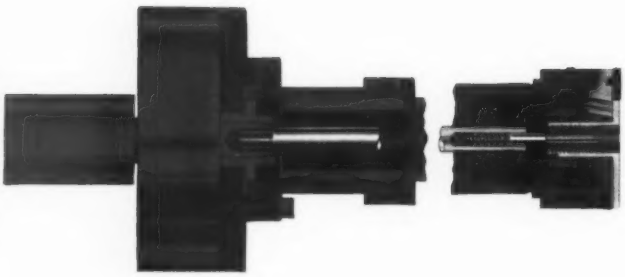
SKINNER



A heavy-duty power chuck with jaws that freely index under full pressure. Indexing is simple, easy, and fast. The operator can index manually without touching the work or releasing the pressure. Jaws are indexed by means of a lock screw and slide plate. Note the size and shape of the indexing pin. It fits firmly and positively into the indexing plate so that extreme accuracy of indexing is assured.

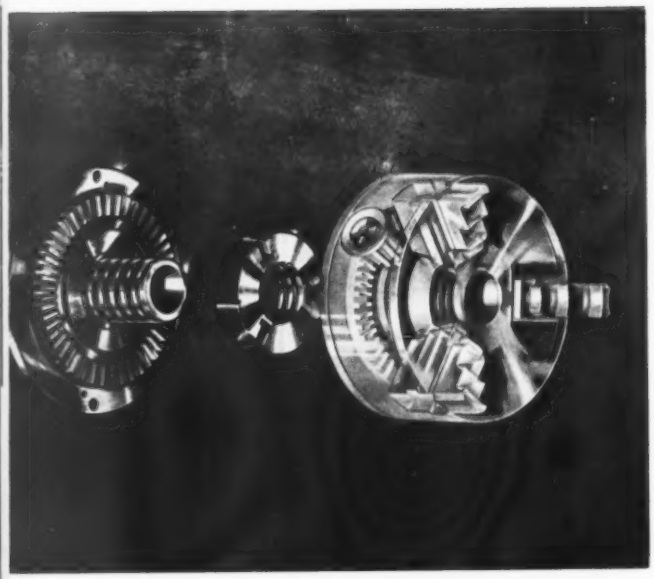
One or both jaws can be furnished with indexing mechanisms. As a result, you can index more positions and smaller index angles. There is no need to buy a new chuck for different indexing positions because index jaws or index components can be interchanged quickly and easily.

This new Skinner chuck is available in all body diameters from 12″ through 36″.



The only power chucking unit for Brown & Sharpe and similar automatic and hand screw machines. The addition of this unit to your screw machine permits power chucking of cold drawn parts, small or odd shapes and castings.

The Skinner unit, recommended by Brown & Sharpe, consists of a 4-inch air chuck with two or three jaws and work ejector, a threaded draw bar, a rotating air cylinder and a cylinder adapter. Hand, foot, or solenoid valves and power chucking accessories are also available. Average installation time—ninety minutes.



The first major chuck development in fifty years! This extra-heavy-duty Wedge-Screw chuck develops tremendous gripping power, high accuracy and repeatability by a unique principle. When the lug-type pinion is turned manually or by a power wrench, it engages the gear plate causing the screw to move the wedge. The force of the wedge on the jaws holds the work with tremendous power.

This Wedge-Screw chuck has such useful features as:

Accuracy—within .001 total indicator reading

Repeatability—within .0005 total indicator reading

Complete Range—no size limitation

Many other features including over-tightening and operator protection, sealed operating mechanism, automatic lubrication, etc.

For more information about these major chuck developments, contact your Skinner representative or write directly to us.

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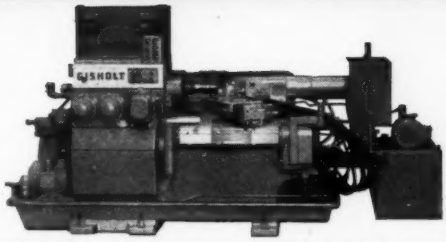

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As practical for small lots as large production runs.

All three feature rugged construction, ease of control and fast setup. Single- or multiple-pass JETracing (shown) can be part of the automatic cycle for lower tool costs, even faster setup, minimum inspection and increased versatility of the basic machine.

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The savings offered by recent developments in Gisholt Automatics may surprise you.

New, faster setup methods up profits on smaller runs. Tracers cut tool costs and handle more complex work. Speed, capacity and horsepower is up . . . for maximum production with carbides.

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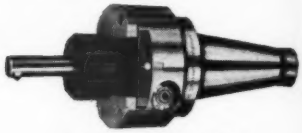

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CIRCLE INFORM-A-GRAM KEY NO. 22

TOOLING & PRODUCTION
The Magazine of Metal Working Methods

Numerical Control— An Adventure In Modernization

MODERNIZATION may have tiresome connotations—its implementation plagues us—but let's condition ourselves to live with the continual need to remain competitive.

So you have read something similar before . . . you're tired of the competitive preach, then look at *modernization* as an adventure. If your *modernization* centers around numerical control, you'll find it steeped in "goldrush excitement." And although there's talk to the contrary, most smart companies are already "in" if NC fits their frame of operation.

Large plants have been adding rows of NC complexes, and small plants with modest NC investments are underway and getting experience. Those not yet using NC fall into any number of categories: some are not imaginative, others are too satisfied with their profitable "corner," others may be semi-indolent and some really can't justify the purchase.

Those who can't see their way clear because of price probably think it's too high. But is it high when you consider the cost of R&D? The Autoprompt system, explained in this issue, tallied up twenty-five man years of development time between IBM, Pratt & Whitney, Aerospace Industries and others. True, all developments are more expensive in their infancy (NC is approximately ten years old), but a word of caution: consider carefully if it's prudent to wait until the prices are lower before you make the move.

Don't begrudge R&D its due. Consider the true criterion of NC. Your decisions should be based on the advantages the control concept can bring to your facility in versatility, production increase, and competitive edge. You could find yourself in another league.

It's no coincidence that Sheffield and IBM each released NC developments (see coverage in this issue) the same month. Many are "burning the oil" working to enhance and extend its use, and the results of the compounding of breakthrough upon breakthrough over the next few years will have a tremendous impact on our industrial way of life.

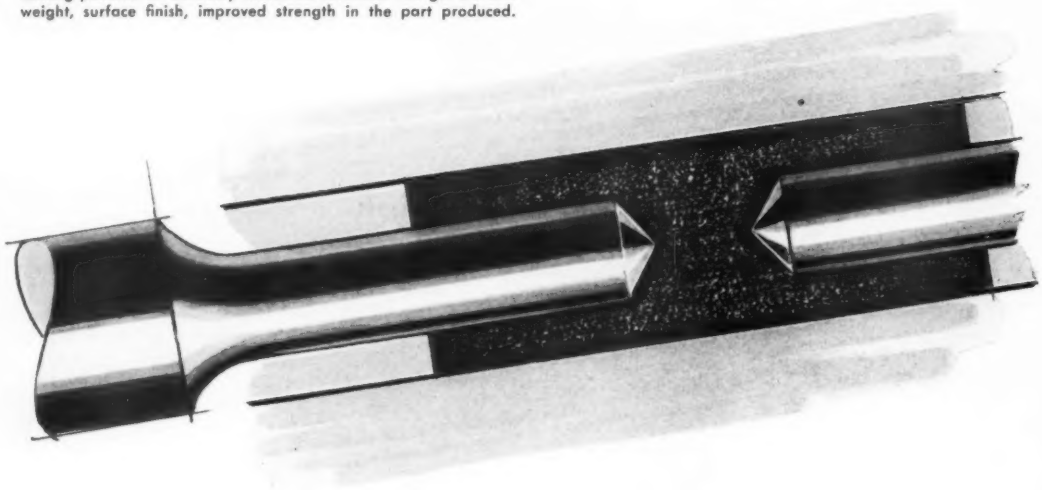
In the aggregate, it would only be natural that some who have tried NC are disappointed. We have talked to a few who were, but none were discouraged to any extent; the implications of future success were readily evident.

Proceed with care, but do proceed. Apprise yourself of the infinite possibilities and long term implications of numerical control.

William E. Hoffman
Editor

"MOVING METAL" with Carboloy® Cemented Carbides

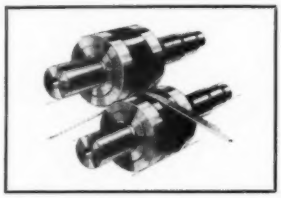
From solid slug to wrist pin — 2,000 an hour! Increased production is but one of the advantages when you use extruding and coining punches of Carboloy cemented carbides. You get uniform weight, surface finish, improved strength in the part produced.



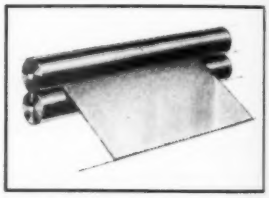
Reduce costs, save machining time with Carboloy® cemented carbides

How efficiently you "*move metal*" from one shape to another depends on the quality, accuracy and uniformity of the carbide you use. General Electric Carboloy carbides for coining and extruding punches, wire-flattening and sheet metal rolls are designed to do the job better, in less time, at lower cost, with less metal waste.

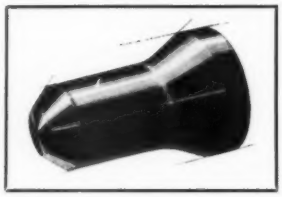
Continuing research by General Electric's metallurgists and technicians results in carbides of highest quality and uniformity — dependability for the job at hand. Call your Carboloy Die Distributor or Die Maker to help you "*move metal*" at lower cost. Or write: *Metallurgical Products Department of General Electric Company, 11111 E. 8 Mile Street, Detroit 32, Michigan.*



When it comes to wire flattening, rolls of Carboloy cemented carbide outlast steel rolls many times. Smooth, wave-free roll surfaces produce rolled-flat wire products of exceptional quality and finish; consistent uniformity.



You get uniform, more even sheet when you use rolls of Carboloy cemented carbides. Roll structure is uniform throughout; excellent for working stainless steel. Carboloy rolls last longer and do jobs not possible with steel rolls.



Cold extrusion punches made of G-E carbides find a wide variety of applications. For example, in the production of bearings, a solid carbide punch forms a race and cup from one steel slug—minimum waste; saves machining.

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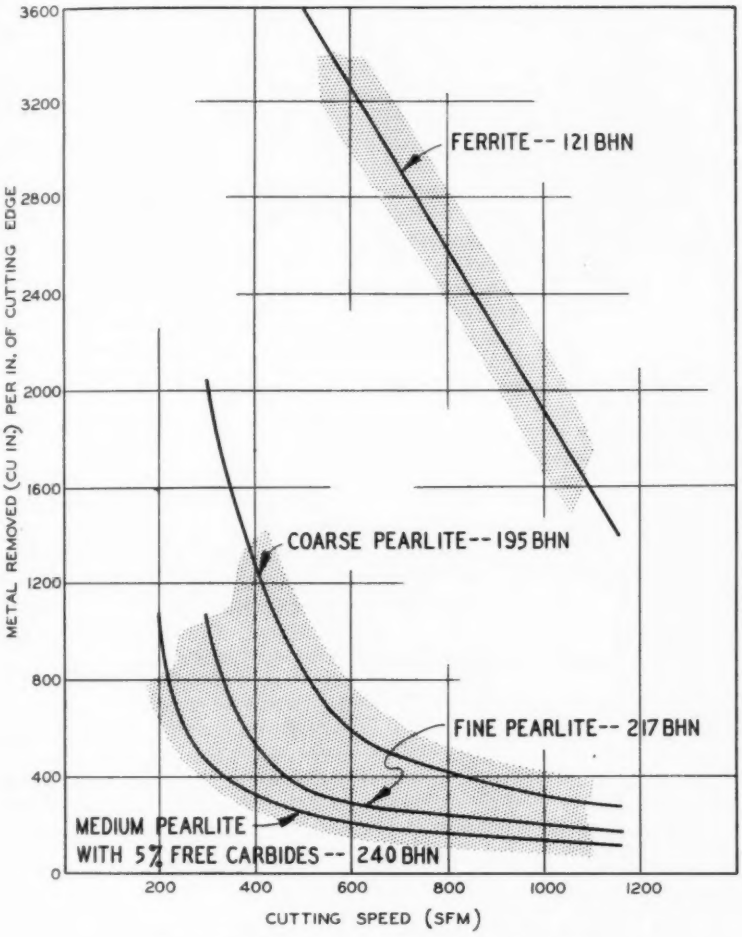

Fig. 1. Tool life curves for milling different gray irons.

by Charles F. Walton

Mr. Walton is Technical Director, Gray Iron Founders' Society, Inc., Cleveland, Ohio.

How To Increase Tool Life When

Machining Gray Iron

SELECTING CUTTING SPEEDS and feeds for gray iron castings on the basis of hardness alone will not always guarantee the same maximum cutting tool life.

Although hardness is generally a good indication of machinability, it's not the only property of a gray iron that affects the life of cutting tools. A more direct influence on tool life is the actual microstructure of the iron.

The microstructure of gray iron is largely determined by chemical composition and rate of cooling. While these factors also determine hardness, unfortunately the correlation between them is not direct.

What Is Microstructure?

Essentially, the microstructure of gray iron consists of 1) graphite, which may occur in several different forms and 2) metal surrounding the graphite. The sur-

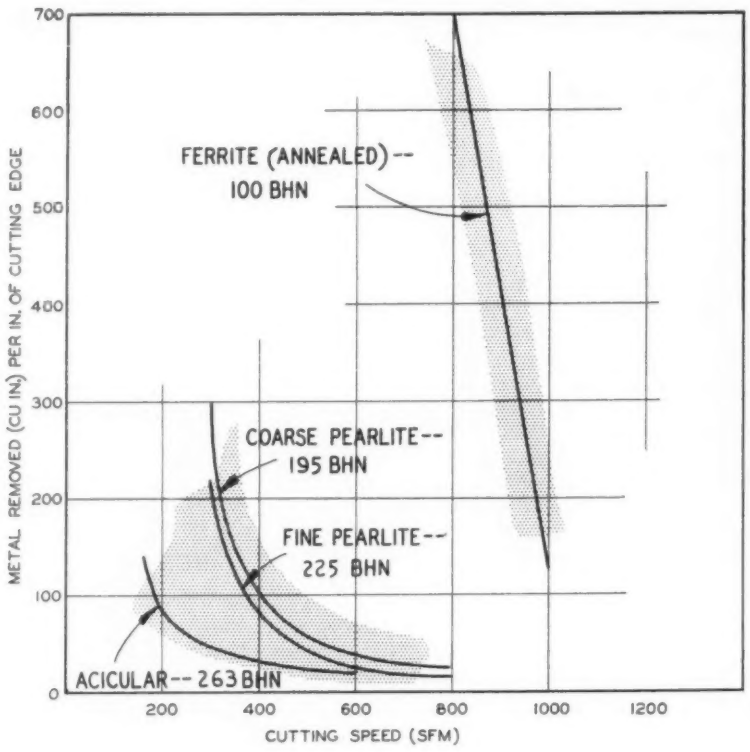

Fig. 2. Tool life curves for turning different gray irons.

rounding metal is commonly called the matrix structure.

Although the graphite is important to tool life because of its effect as a chipbreaker and lubricant, the shape and amount of graphite are not critical to tool life within the ranges that occur in the common types of gray iron castings.

However, tool life is directly affected by the microstructure of the matrix which contains the graphite. By changes in chemical composition and processing, or by heat treatment, the combined carbon content and the resulting matrix structure in the casting is comparable to steel in its range of microstructure. These structures may resemble soft mild steel, medium carbon steel, eutectoid tool steel, or high carbon tool steel.

Because of this wide range of microstructures, there is an equally wide range in tool life. And before optimum machining conditions can be set up, the microstructure of the castings must be known.

Types of Microstructure

Specific microstructures may be identified by the constituents in the gray iron. In the shop, these matrix structures may be identified by the ASTM class number specified on the print. Four typical matrix structures, and the ASTM class numbers of gray irons in which they appear, include:

Ferrite. Gray iron with a ferrite matrix is by far the most machinable. Ferrite, which is essentially carbon-free, contains silicon and manganese in solution. This structure is typical of all classes of gray iron in the annealed condition. Brinell hardness ranges from 120 to 160.

Coarse pearlite or ferrite and pearlite. Pearlite is actually alternate layers of soft ferrite and hard iron carbide. Irons containing mixtures of ferrite and pearlite have intermediate machinability. In low and medium strength irons, Class 25 and 30, Brinell hardness ranges from 140 to 187.

Fine pearlite. When pearlite's layers of ferrite and iron carbide are too fine to be resolved, it has a gray, mother-of-pearl appearance. The finer the structure, the stronger and harder it is, and more difficult to machine. In medium strength irons, Class 30 and 35,

TABLE I—RECOMMENDED CUTTING SPEEDS & FEEDS

SPEEDS

Matrix Structure	Turning	Face Milling	Cutting Speed (fpm) Drilling	Reaming (Multiple-flute)
Ferrite (fully annealed)	800	600	200	200
Coarse pearlite or pearlite and ferrite	300	320	175	140
Fine pearlite	250	270	150	120
Acicular (alloy or heat treated)	125	170	100	80

FEEDS

(for all matrix structures)

METHOD	Drill Size (in.)	Reamer Size (in.)	Feed (ipr)
Turning			0.020 to 0.035
Face Milling			0.012 to 0.020
Drilling	1/8		0.002
Drilling	1/4		0.005
Drilling	1/2		0.012
Drilling	1		0.015
Reaming		1/4 or less	0.005 to 0.010
Reaming		1/4 to 1/2	0.010 to 0.020
Reaming		1/2 to 1	0.020 to 0.030
Reaming		1 to 2	0.030 to 0.100

Brinell hardness ranges from 190 to 230. In high strength irons, Class 40 and 50, Brinell hardness ranges from 217 to 240.

Acicular. An acicular matrix structure, consisting of needle-shaped constituents, is obtained without heat treatment by alloying, generally with nickel and molybdeum. It is more difficult to machine than fine pearlite. In these high strength irons, Class 55 and 60, Brinell hardness ranges from 243 to 320.

Effect of Microstructure

Notice that a certain relationship does exist between the hardness of these matrix structures and their machinability. However, a direct correlation between hardness and tool life is not valid without considering the specific properties of the matrix structure.

To illustrate this, tool life curves for milling gray irons with four different matrix structures are plotted in Fig. 1. The gray iron containing a coarse pearlite shows a tool life of 1300 cu in. at a cutting speed of 400 fpm. This is twice that for the fine pearlite iron, although their respective Brinell hardness numbers are 195 and 217. A comparison of hardness alone would not indicate the great difference in machinability. Fig. 2 shows similar curves for turning.

Tool life may also be affected by the presence of free carbides in the structure of pearlite. Free carbides, which are normally avoided, may be found when chromium has been added to gray iron for wear resistance or elevated temperature service. These free carbides may appear as small masses, or as a network around the pearlite. As little as 5% free carbide can reduce tool life as much as 70%.

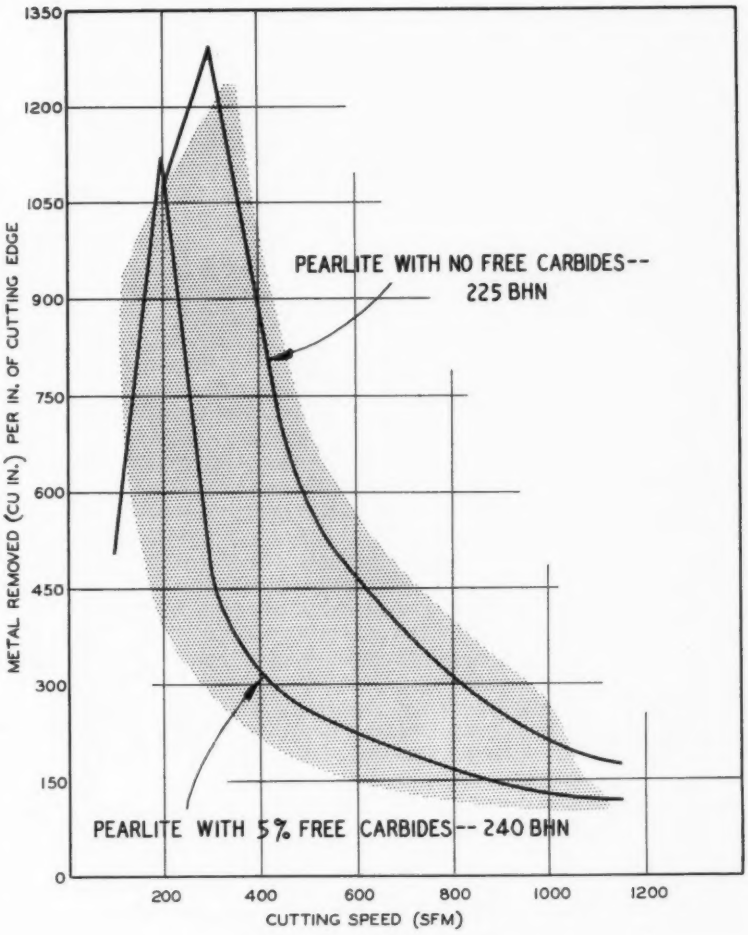

Fig. 3. Effect of free carbides.

This is shown in Fig. 3, which compares tool life curves for two pearlite gray irons which are similar except that one contains about 5% free carbide in the matrix structure. Thus, at 300 fpm, the tool life for the iron without free carbides is 1300 cu in. and only 450 cu in. for the one with 5% free carbides.

TABLE II—RECOMMENDED CARBIDE GRADES

Trade Name	Roughing Cuts	General Purpose	General Finishing	Precision Finishing
ADAMAS	B	A	AA	AAA
CARBOLOY	44A	883	905	999
CARMET	CA3	CA4	CA7	CA8
FIRTHITE	H	HA	HE	HF
KENNAMETAL	K6	K6	K8	K11
TALIDE	C88	C91	C93	C95
VASCOLOY	2A68	2A5	2A7	
WESSON	G5	G1	GA	GF
WILLEY	E-8	E-6	E-5	E-3

Selecting Speeds, Feeds

For maximum tool life, the proper cutting speeds and feeds for various gray iron castings are therefore more accurately selected on the basis of microstructure than hardness alone. Recommended speeds and feeds for turning, milling, drilling, and reaming the four typical matrix structures are listed in Table 1.

The speeds and feeds are for carbide tools, since these tools are widely used to machine gray iron. Table II gives various manufacturers' recommendations for grades of carbides which may be used.

Tool life, as expressed in the various curves, is reached when the tool is dulled to the condition where it can be reground economically. On a single-point tool, this occurs when a wear land of about

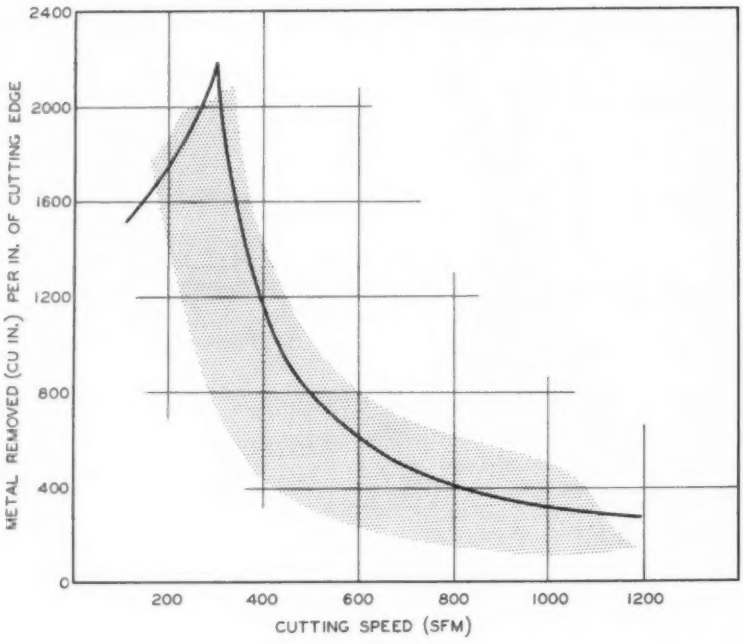

Fig. 4. Typical tool life curve. Milling ASTM class 30 gray iron, 195 bhn, 0.015" tooth feed.

1/32" forms on the flank of the tool.

The most practical cutting speed and production rates may be determined from the tool life curves, which relate volume of metal removed to cutting speed. In order for "volume of metal removed" to have significance, the depth of cut must be specified. In these curves, the values for tool life are expressed in cubic inches of metal removed for a 1" depth of cut.

With this unit depth, the data on a curve may be converted to any desired depth by changing the value for metal removed in direct proportion to the actual depth of cut. For example, if the depth of cut is 0.250, the volume of metal removed will be ¼ that given in the tool life curves. The tool life, in terms of time, is independent of depth of cut.

A typical tool life curve, demonstrating the effect of speed on tool life, is shown in Fig. 4. Except at cutting speeds below 300 fpm, an increase in speed causes a corresponding decrease in tool life. The decrease in tool life below the critical speed of 300 fpm is a common characteristic of gray irons.

Tool life curves for various feeds at a given speed are shown in Fig. 5. The curves peak at the higher feed, showing that, up to a point, better tool life is obtained at heavier feeds.

What About Casting Skin?

With the exception of an unusual design or requirement, machining the skin from a gray iron casting should be no problem, particularly when a normal depth of first cut is used. The first cut can shorten tool life if the surface is not free from abrasive material, such as sand from the mold adhering to the surface, or sand actually fused into the surface.

With modern foundry practice and equipment, gray iron castings can be consistently produced with clean surfaces. However, there may be special cases where it would be more economical to tolerate a reduced tool life or lower cutting speed on the first cut than to utilize special casting or cleaning techniques to avoid it. ■

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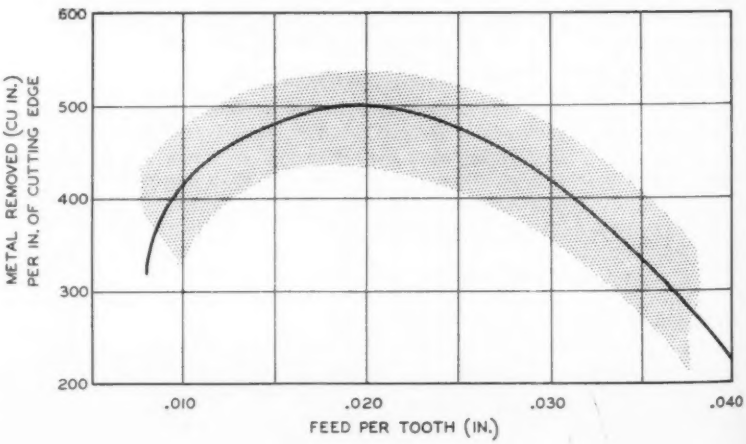
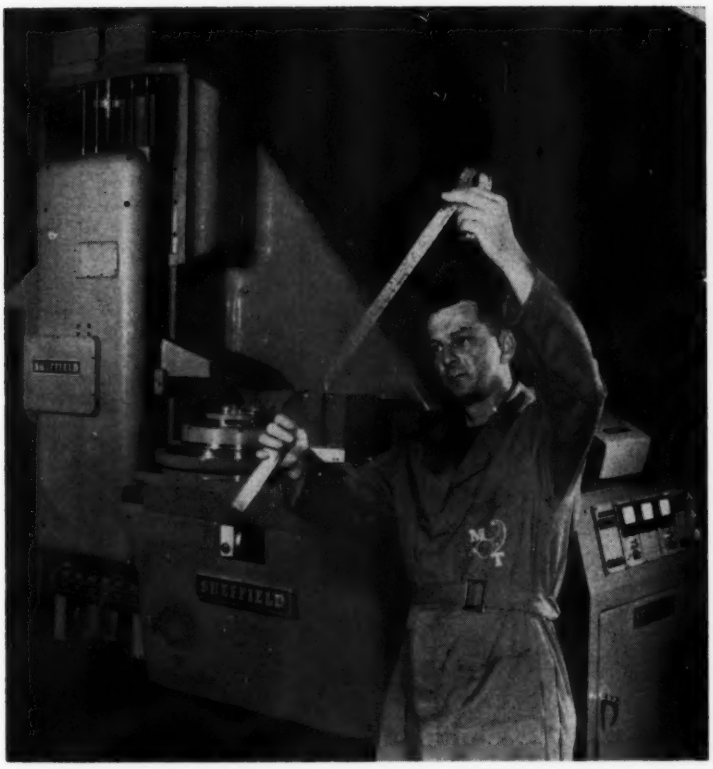


Fig. 5. Effect of feed on tool life. Milling pearlite with 5% free carbides, 240 bhn, 290 sfm.



Speed, Versatility, Accuracy

Over-all Dimensional Inspection of Complex Shapes with a Minimum of Fixturing

THE SHEFFIELD UNIVERSAL tape-controlled coordinate measuring machine slashes cost, offers repeatability in measuring compound shapes such as missile nose cones. This instrument can automatically and simultaneously measure, indicate, and record inside and outside dimensions, contour, and wall thickness of a part. The tape control can direct the machine to accomplish almost 1000 precise measurements (e.g. wall thickness to 0.000050) in just 2 hrs.

It is possible for the machine to take 100,000 readings on a single inch of test part. It is reported that any shape up to 20" high and 20" in length can be measured.

A representative task might be a hemispherical part for which a point of inspection is required at every 2° latitude and every 60° longitude for outside contour, inside contour and wall thickness. This requires 795 exacting gage readings, and 265 mathematical computations for wall thickness.

Using conventional techniques, this would require more than 125 hrs, and it is doubtful that the same degree of accuracy would be achieved. The Sheffield machine accomplishes all this in about 2 hrs.

Though sophisticated, the components employed are rather familiar, but are ingeniously combined. Two slide-mounted electrojet (differential transformer) gage cartridges are the sensing elements. One contacts the inner surface of the part and the other the outer

Fig. 1 Engineer checks transparent dome for precise wall thickness and uniform contour simultaneously on Sheffield tape controlled gage.

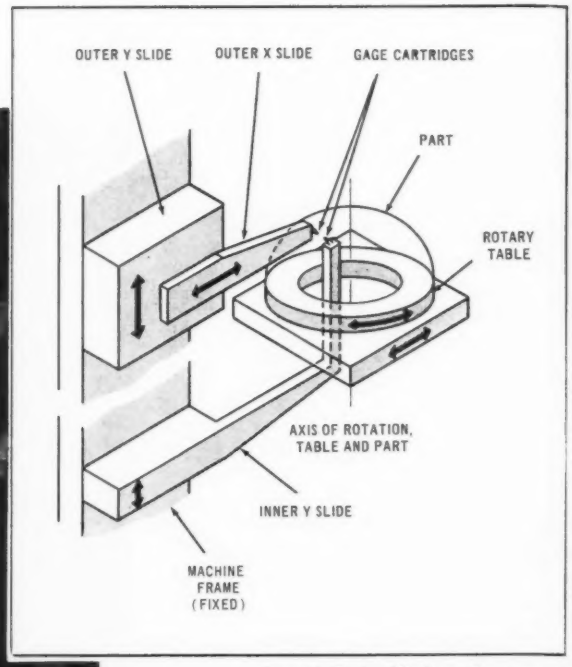


Fig. 2 Basic Motions for accomplishing complete dimensional inspection of test shape.

surface. The rolling ball contacts permit tramming an angle more accurately than is possible with a fixed stylus, and minimize the danger of damaging highly finished surfaces. Signals from the electrojets are fed to Accutron electronic amplifiers. These couple with the numerical control unit, which compares the information being received with the parameters and tolerances previously programmed onto the controlling tape. The deviations from the nominal so detected are then automatically printed out in tabular form.

This machine features a high degree of versatility. For example, the probes can be made to scan a prototype part, and to punch a tape which will cause subsequent parts to be inspected by the original standards. It can be operator-controlled without benefit of tape program.

Not everyone is producing nose cones, and the foregoing examples may lend the impression that the use of the machine is limited to that product. However, the machine can handle any gaging operation requiring OD, ID, wall thickness, and contour data.

A salient feature is that of virtually eliminating special-purpose gage tooling and fixturing. ■

More to Fourslide

The fourslide method can be more than a mere interaction of four slides directed toward a common center.

"Nilson Fourslide Design & Tooling Handbook," issued by A. H. Nilson Machine Co., mirrors the extreme adaptability of the fourslide process. Eight case histories mentioned in the book show the great possibilities placed at the engineer's fingertips, limited only by his own imagination. By the incorporation of a press unit with the fourslide machine expensive handling and secondary operations are eliminated. Costly trimming operations are avoided through use of coil ribbon metal stock cut to required dimensions. Forming parts to precise tolerances with basic equipment of the fourslide eliminates the need for expensive auxiliary units, and handling time is cut to a minimum. The fourslide operator, the production manager, the industrial or manufacturing engineer, the tool engineer and the product designer should find this book of great value. Write the A. H. Nilson Machine Co., 600 Bridgeport Ave., Shelton, Conn., or circle No. S30 for your free copy.

Treat The Surface For Longer Tool Life

Edge wear on cutting tools can be reduced by treatments which change the surface composition of the tool. The specific treatment depends on the workpiece and tool material, and on the job to be done.

by Edward A. Steigerwald

Dr. Steigerwald is a research engineer in Staff Development, Tapco Group (Cleveland), Thompson Ramo Wooldridge, Inc. Readers may remember his previous Tooling & Production articles, "Heat Treatment of Tool Steels" (March 1960), and "Tool Steel Troubleshooting" (Sept. 1960).

WITH CUTTING TOOLS it's the surface that counts. No other metal tooling component depends so completely on a localized condition for ultimate performance. The heat treater takes great pains to insure that surface decarburization does not alter the steel chemistry and produce a soft cutting lip. The grinder must make certain that he does not overtemper the tool and that the proper geometry exists. All these considerations are important, because performance of cutting tools and dies is governed by surface wear. Surface treatment can be effectively used to decrease wear and increase tool life.

Since wear is governed by the properties of the tool, the workpiece, and the operating conditions, a particular surface treatment may only be effective within certain ranges of these three variables. For example, a surface treatment which reduces the friction between a drill and a steel casting may not be effective on an aluminum workpiece. Despite these differences, there is merit in discussing the properties produced by certain surface treatments. A wise choice of the proper treatments for a particular application can lead to substantial improvements in performance.

Although surface finish can also improve or deteriorate tool performance, only treatments which alter the surface chemistry of the tool will be discussed in this article.

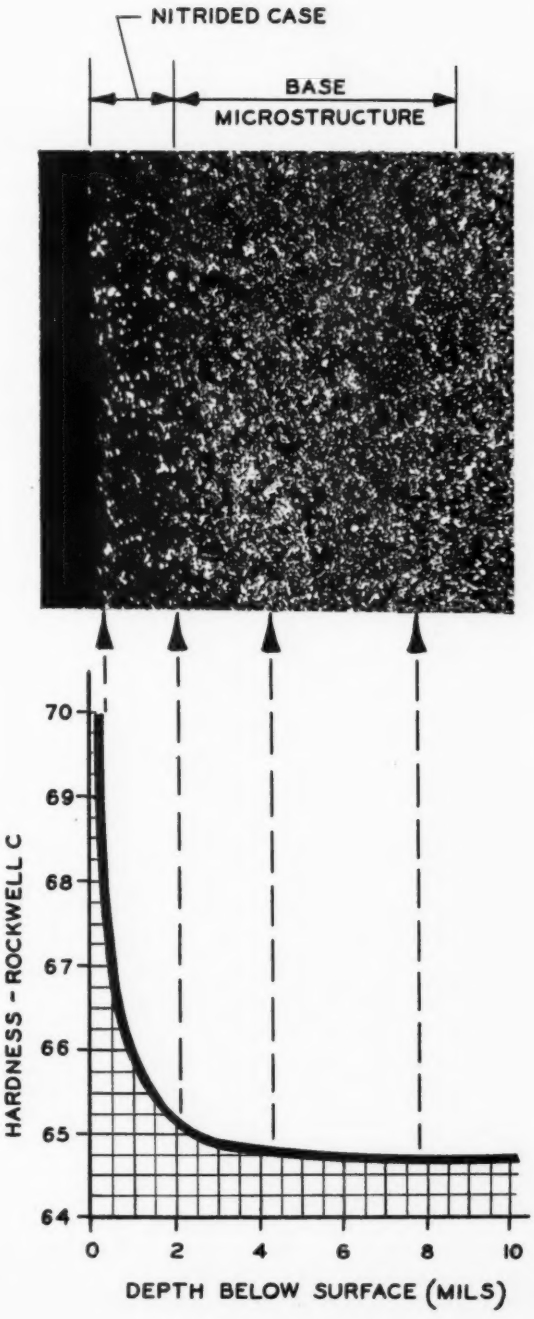


Fig. 1 Hardness of nitrided case and appearance of microstructure for an M-1 high speed drill. Magnification 250X.

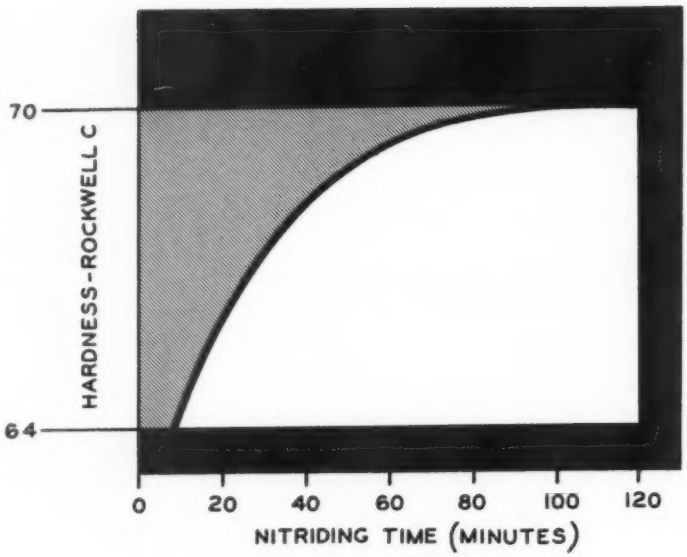


Fig. 2 Influence of nitriding time on the hardness of a T-1 high speed steel surface.

Nitriding

The most generally used and most effective surface treatment for tool steels is nitriding. It produces a hard, thin, extremely wear-resistant surface zone which ranges in depth from 0.0002 to 0.001 (Fig. 1). The nitrided layer is particularly effective when tools are used for light cuts on hard or abrasive materials such as cast iron or plastics. The hard surface is produced by immersing the tool in an aged bath composed of a mixture of molten sodium and potassium cyanide salts at approximately 1000°F. The treatment can last from 10 min to 1 hr depending on the particular tool, desired case depth, and maximum hardness (Fig. 2). It causes no effective dimensional change, hence it can be used on a finished tool and substituted for a second tempering operation. Although the extremely hard (R_C69) diffusion-bonded nitride case slightly decreases overall tool toughness, the decrease is generally not harmful, provided the case depth is below 0.001.

Testing for the brittleness of a nitrided case is difficult. Although actual performance tests are the ultimate criterion, a convenient rule of thumb is to scratch a piece of window glass with a sharp nitrided tool edge. A brittle edge will spall and dull quickly, while a satisfactorily nitrided surface will last much longer.

The effectiveness of the nitrided case of drills and reamers persists even after the tools have been resharpened. Although the hard layer is removed from the point of a tool, sufficient "back-up" apparently exists in the flute section to give support and wear resistance to the cutting edge.

Long gas nitriding cycles are used to produce a considerably heavier nitrided case (0.004 to 0.016) in large hot working dies.

The relatively simple and economical nitriding treatment can produce substantial dividends in increased tool performance. Certain precautions are necessary, however, to account for the toxicity of the cyanide salts.

Chromium Plating

The low coefficient of friction and moderately high hardness of electrodeposited chromium plate (Fig. 3) has led to its application on certain dies, gages, and cutting tools. Although the case hardness (R_C65) is less than a nitrided surface, the chrome-plate reduces friction between tool and chip, and life is increased because of the reduced tool tip temperatures and stresses. This plating is applied directly to the steel, setting up tensile stresses on the surface. These stresses decrease the toughness of plated material as compared to unplated stock. Plate thicknesses usually range from 0.0001 to 0.0003 to insure optimum adherence. In cases where undersize cutting edges must be increased, plate thickness may go as high as 0.010.

Considerable care is necessary during plating to insure maximum resistance to spalling. A typical chrome-plate cycle involves degreasing, electrolytic cleaning, anodic etching, plating in a manner to insure relatively constant current distribution over the workpiece, baking, and finish machining if necessary.

The operations may appear involved, but they require only a modest capital investment and normal care. More commercial plating employs motor generator sets capable of producing 6 to 12 volts. Wood or lead-lined tanks are required for most of the operations, and relatively good temperature control must be maintained during the actual plating cycle.

The baking operation, required to eliminate the hydrogen taken up during the electrolytic operations, is performed below 500°F for 4 to 12 hrs. It substantially decreases brittleness, but does not change surface hardness.

Controlled chrome plating, like nitriding, can be applied to a finished tool. It's more costly than nitriding and must be considered as a specialty surface finish, but its effectiveness can be significant in certain cases. For example a normal high speed drill, used for drilling ¾" hard brass with a paraffin oil lubricant, drilled 524 holes before chrome plating; it went almost 3000 holes after plating.

TABLE I

SURFACE TREATMENTS FOR TOOL STEELS

Treatment	Process	Method of Application	Characteristics of Surface	Use
Nitriding	Add nitrogen to surface	Immerse tool in cyanide salt at 1000°F.	Very hard, wear resistant	Light cuts on hard abrasive materials.
Chrome Plate	Plated layer	Electrolytic plating on finished tool.	Low coefficient of friction.	Specialty applications.
Steam Oxide	Adherent, very thin oxide	Temper in dry steam atmosphere at approx. 1000°F.	Good friction characteristics, possible lubrication absorption.	Predominantly on cutting tools for ferrous applications.
Sulfurizing	Add sulfur to surface	Immerse tool in special cyanide salt at approx. 1000°F.	Anti-weld and lubricating surface.	Metal-to-metal rubbing contact.
Chromizing	Add chromium to surface	High temperature deposition on tool prior to or during hardening.	Very hard, abrasive chromium carbide surface.	Carbon tool steels for wear resistance.

Oxides

Steam oxide treatments can also be applied to a completed tool. The oxide film is produced in a tempering furnace with a dry steam atmosphere at approximately 1000° F. If care is taken to prevent formation of rust spots, a uniform bluish-black film is produced on the tool (Fig. 4). Numerous tests have indicated that the steam oxide film improves the life of cutting tools used to machine ferrous materials, but has a relatively small effect on tools used for nonferrous work. This suggests that the frictional characteristics of the film control performance. There are also some indications that the film may be porous and acts as an effective trap for the cutting lubricant. Although this blue-black film is the most widely used surface oxide, a variety of colors ranging from straw or yellow to deep black can be produced by varying the time and temperature of the treatment.

Another oxide treatment, done during hardening instead of on the finished tool, is carried out at approximately 2200°F in an atmosphere furnace. Since the tool must be finish ground after heat treatment, the 0.001 thick high temperature oxide is removed from the cutting edges and remains only in the flutes. This results in a dark colored flute section, and bright, finish ground cutting surfaces. Whether or not this type of finish is beneficial is somewhat controversial. It has been reported to improve performance in certain tests; the cause is believed to be its ability to absorb lubricants.

Sulfurizing

The sulfurizing process, recently developed in France, increases the sulfur content of ferrous metals to controlled depths beneath the surface. The method, similar to nitriding, involves immersing the tool in a molten bath of alkali metal cyanide and neutral salts

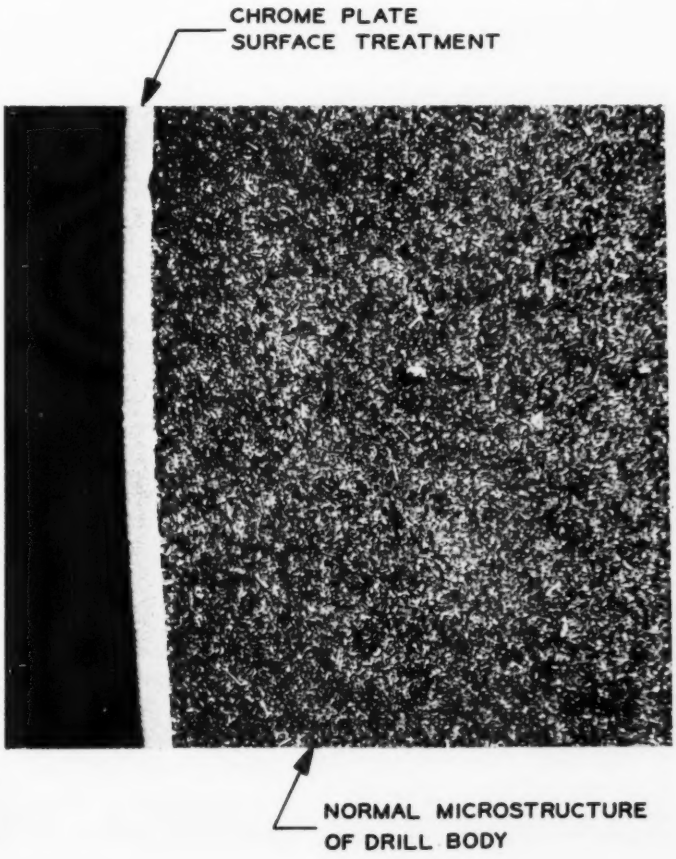


Fig. 3 Appearance of hard chromium plate approx. 0.0007 in depth on an M-1 high speed drill. Magnification 250X, structure etched with Nital.

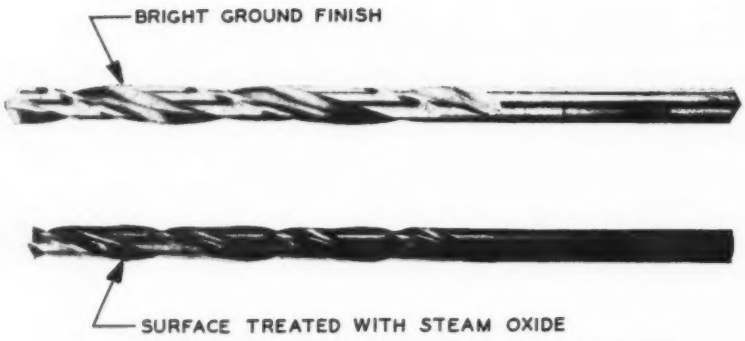


Fig. 4 Blue-black appearance of steam oxide-treated drill contrasts with appearance of bright ground drill.

with sulfur, rather than nitrogen, as the active diffusing agent. While the beneficial effect of nitriding is produced by high hardness, the advantages of sulfurizing are attributed to its anti-weld and lubricating effectiveness. Sulfurizing has been most effective on machine parts involving metal-to-metal rubbing contact, but has not found wide acceptance on more highly stressed cutting tools.

Chromizing and hard flame-sprayed surfaces also find limited application on tool materials. In chromizing, chromium is diffused into the surface of the tool where it generally combines with carbon to produce a very hard, wear resistant chromium carbide. It is effective on carbon tool steels, but has not been successfully applied to high speed tool steel. Flame-sprayed coatings, due to their spalling tendencies, are only employed for applications involving relatively low surface stresses. Both of these treatments require subsequent finish machining.

The tool surface treatments discussed here (Table I) do not represent the entire gamut of possibilities, but have been widely used with good results. In evaluating any surface treatment, the cost must be weighed against the degree of improvement. These factors can be extremely dependent on particular production conditions. ■

Extra copies of this article are available while supply lasts. Write Tooling & Production Magazine 1975 Lee Road, Cleveland 18.

More RPMs For Drills

The Jarvis Drillspeeder converts your conventional drill press into a high speed drilling machine. With a maximum speed capacity up to 30,000 rpm, it is reportedly ideal for high speed drilling of very small holes. Due to the 4 to 1 ratio of its gear train, it results in increased production and job versatility when working brass, aluminum, plastics, cast iron and other metals. Whatever the standard or selective speed of your drill press, the Drillspeeder multiplies this by four. This gives the speeds compatible with its chuck capacity, which is from No. 80 to 5/32".

For the quiet and smooth running essential to efficient use of the small wire size and fractional millimeter drills, heat treated precision gears are employed. Further contributions to accuracy stem from the preloaded, shielded high speed ball bearings. The spindles, of heat treated steel and ground after hardening, insure a minimum of "run out" so essential to trouble-free performance of miniature drills. Because all moving parts are fully enclosed and lubricated at the factory, the Drillspeeder may be used in either horizontal or vertical position.

Illustrated literature and detailed specifications may be had from Jarvis Corp., Middletown, Conn., or circle D1 on your Inform-A-Gram Card.

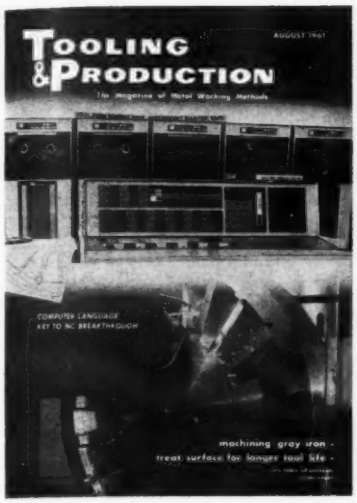
Metal Literature

ASM REVIEW OF METAL LITERATURE 1960, edited by Marjorie R. Hyslop. Published by American Society for Metals, Novelty, Ohio, Vol. 17, June 1961, 1342 pages, $25.00.

This volume is a collation of monthly issues of the ASM Review of Metal Literature from January through December 1960. It is the seventeenth volume of a series that began in 1944.

The clothbound book contains 11,903 annotations of articles, technical papers, reports and documents that appeared in engineering, scientific and industrial journals and books throughout the world in 1960. The annotations are brief abstracts indicating scope and content of the article. They are not intended to serve as a substitute for a reading of articles listed. They merely give the reader a chance to decide whether he wants to read material in its entirety. A register of publications and their addresses aids in obtaining back issues or reprints.

The book is divided into 20 sections covering different areas of materials and process engineering and technology.



From the Cover:

Computer Language Is Key to NC Breakthrough

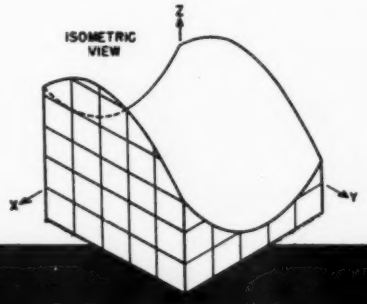
WHETHER YOU HAVE a computer or not, you may profit from IBM's introduction of "Autopromt," a system that puts infinitely improved numerical control within reach of an NC-equipped facility.

The word "Autopromt" is an abbreviation for *Automatic Programming of Machine Tools*, and words are the key to this system's significance. Heart of the system is a new computer language that circumvents the need for a programmer to numerically describe the cutting tool's point-to-point path—a fantastic time-saver. Heretofore, where fine milling finishes were desired, hundreds of tool position coordinates might have to be calculated for a cutting path.

With Autopromt, and working from an engineering drawing of the part, the programmer writes a series of statements in the Autopromt language. He describes each of the constituent surfaces of the three-dimensional shape to be machined (in many instances a word for each shape), defines the relationship of these surfaces to each other, and specifies the machining requirements such as tolerance and tool size, etc. This information, the source program upon which Autopromt bases its computations, is punched into a deck of IBM cards and fed into a 7090 computer.

Then the Autopromt master tape is fed into the computer for storage in its core memory. This series of more than 30,000 instructions enables the computer to interpret the card information and generate automatically the many tool positions necessary for the numerically controlled machine tool to make the desired cut. IBM says instructions produced by Autopromt can be used with any combination of numerical control director device and milling machine.

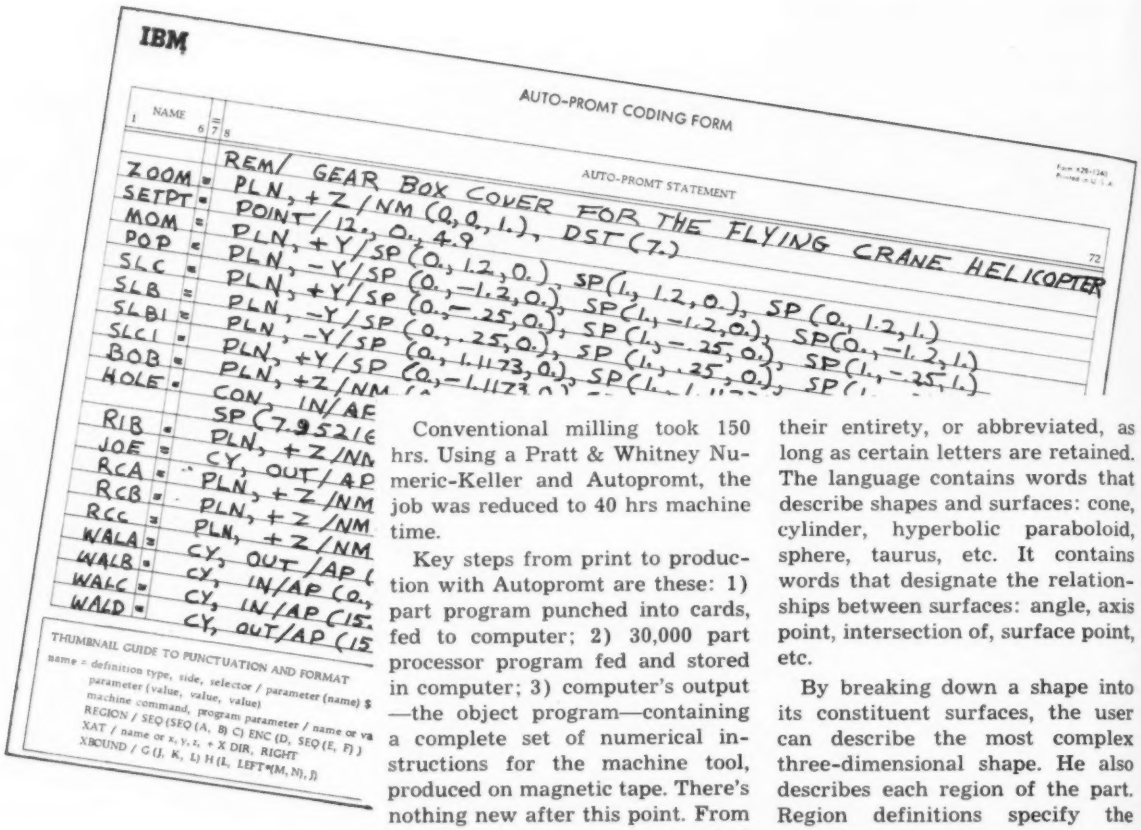
The part first used to demonstrate Autopromt's dramatic capabilities is a gearbox cover for the turbine-powered S-64 helicopter developed by Sikorsky Aircraft, a division of United Aircraft. Its 38" dia surface is broken by 10 identical ribs extending from cone cen-



PROCESSING FLOW IN THE AUTOPROMT SYSTEM

A numerically-controlled machine tool can produce any complex three-dimensional shape from numerical instructions which govern the motions of the cutting tool. Up to now, an engineer has had to first determine the tool paths, and then use a computer to translate his path descriptions into detailed numerical instructions for machining the part. Now with AUTOPROMT, the tedious task of determining the tool paths is also performed by the computer which generates them automatically—when supplied with a simple description of the part surfaces.

(See a related article, the Talk of the Month, "New Generation Dawns for Numerical Control," earlier in this issue.)


IBM

AUTO-PROMT CODING FORM

AUTO-PROMT STATEMENT

REM/ GEAR BOX COVER FOR THE FLYING CRANE HELICOPTER

ZOOM = PLN, +Z/NM (0,0,1.), DST(7.)
SETPT = POINT/12., 0., 4.9
MOM = PLN, +Y/SP (0.,1.2,0.), SP(1.,1.2,0.), SP(0.,1.2,1.)
POP = PLN, -Y/SP (0.,-1.2,0.), SP(1.,-1.2,0.), SP(0.,-1.2,1.)
SLC = PLN, +Y/SP (0.,-.25,0.), SP(1.,-.25,0.), SP(1.,-.25,1.)
SLB = PLN, -Y/SP (0.,.25,0.), SP(1.,.25,0.), SP(1.,.25,1.)
SLBI = PLN, +Y/SP (0.,1.1173,0.), SP(1.,1.1173,0.), SP(1.,1.1173,1.)
SLCI = PLN, +Z/NM (0.,-1.1173,0.), SP(1.,-1.1173,0.), SP(1.,-1.1173,1.)
BOB = PLN, +Z/NM
HOLE = CON, IN/AP
SP(7.95216
RIB = PLN, +Z/NM
JOE = CY, OUT/AP
RCA = PLN, +Z/NM
RCB = PLN, +Z/NM
RCC = PLN, +Z/NM
WALA = CY, OUT/AP
WALB = CY, IN/AP (0.,
WALC = CY, IN/AP (15.
WALD = CY, OUT/AP (15

THUMBNAIL GUIDE TO PUNCTUATION AND FORMAT

name = definition type, side, selector / parameter (name) $
parameter (value, value, value)
machine command, program parameter / name or va
REGION / SEQ (SEQ (A, B) C) ENC (D, SEQ (E, F))
XAT / name or x, y, z, + X DIR, RIGHT
XBOUND / G (J, K, L) H (L, LEFT*(M, N), J)

ter to rim. Autopromt produces numerical instructions for milling a single segment, and the process is repeated 10 times to mill the entire surface. This part helped to point up the additional savings by simplicity of setup. It was only necessary to mount the part on the miller table in some convenient way. Without Autopromt, it would have been nearly mandatory to mount the part on a dividing head.

In conventional operations, with a machine operator working directly from blueprints, leadtime from print to production was about three *months*. With Autopromt on an experimental basis, leadtime was cut to about four *weeks*. In normal operation, leadtime for a similar operation is expected to be only two weeks.

Conventional milling took 150 hrs. Using a Pratt & Whitney Numeric-Keller and Autopromt, the job was reduced to 40 hrs machine time.

Key steps from print to production with Autopromt are these: 1) part program punched into cards, fed to computer; 2) 30,000 part processor program fed and stored in computer; 3) computer's output —the object program—containing a complete set of numerical instructions for the machine tool, produced on magnetic tape. There's nothing new after this point. From here, the program can be punched into cards or paper tape, depending on the input you use for your numerically controlled milling machine.

You have to have NC equipment to profit from Autopromt, but as related at the outset, you don't have to have a computer. Using Autopromt, IBM processing centers will be able to prepare the input for your equipment from your detailed description of the job. Such service can make feasible even small production lots of highly complex, three-dimensional prototype parts. Heretofore, the cost in time and manpower for programming a machine tool to produce such parts couldn't be justified.

The Autopromt language used by a programmer consists of 110 English words. These can be used in their entirety, or abbreviated, as long as certain letters are retained. The language contains words that describe shapes and surfaces: cone, cylinder, hyperbolic paraboloid, sphere, taurus, etc. It contains words that designate the relationships between surfaces: angle, axis point, intersection of, surface point, etc.

By breaking down a shape into its constituent surfaces, the user can describe the most complex three-dimensional shape. He also describes each region of the part. Region definitions specify the grouping of surfaces to be machined and the relationships of these surfaces. In addition, the user provides basic machining instructions for each region, such as mode of machining, size of the cutting tool, dimensional tolerances and feedrate or speed at which the tool will travel.

Autopromt also contains diagnostic features that enable the user to verify his input and locate errors during and after processing. During processing, the computer prints out errors it discovers in the source information. For checking the tool path after processing, and before actual machining begins, Autopromt produces a list of coordinates for each successive tool position. By reading or plotting these coordinates, the user can visualize the entire tool path. ■

The Science of the Super-Cold

ADVANCES IN CRYOGENIC ENGINEERING, Volume 6, edited by K. D. Timmerhaus. Published by Plenum Press, Inc., 227 W. 17th St., New York 11, N.Y., 1961, 662 pages, $15.00.

This is a collection of the proceedings of the 1960 Cryogenic Engineering Conference held at Boulder, Colo. Space technology, superconductivity, transfer phenomena, physical equilibria, cryogenic equipment, mechanical properties, and heat transfer and thermometry are covered.

EX-CELL-O

Contour Projector Used To Aid Nuclear Research

Engineers for the Enrico Fermi Atomic Power Plant used an Ex-Cell-O Model 30 Contour Projector to determine the maximum load that could be applied to a "dimple"!

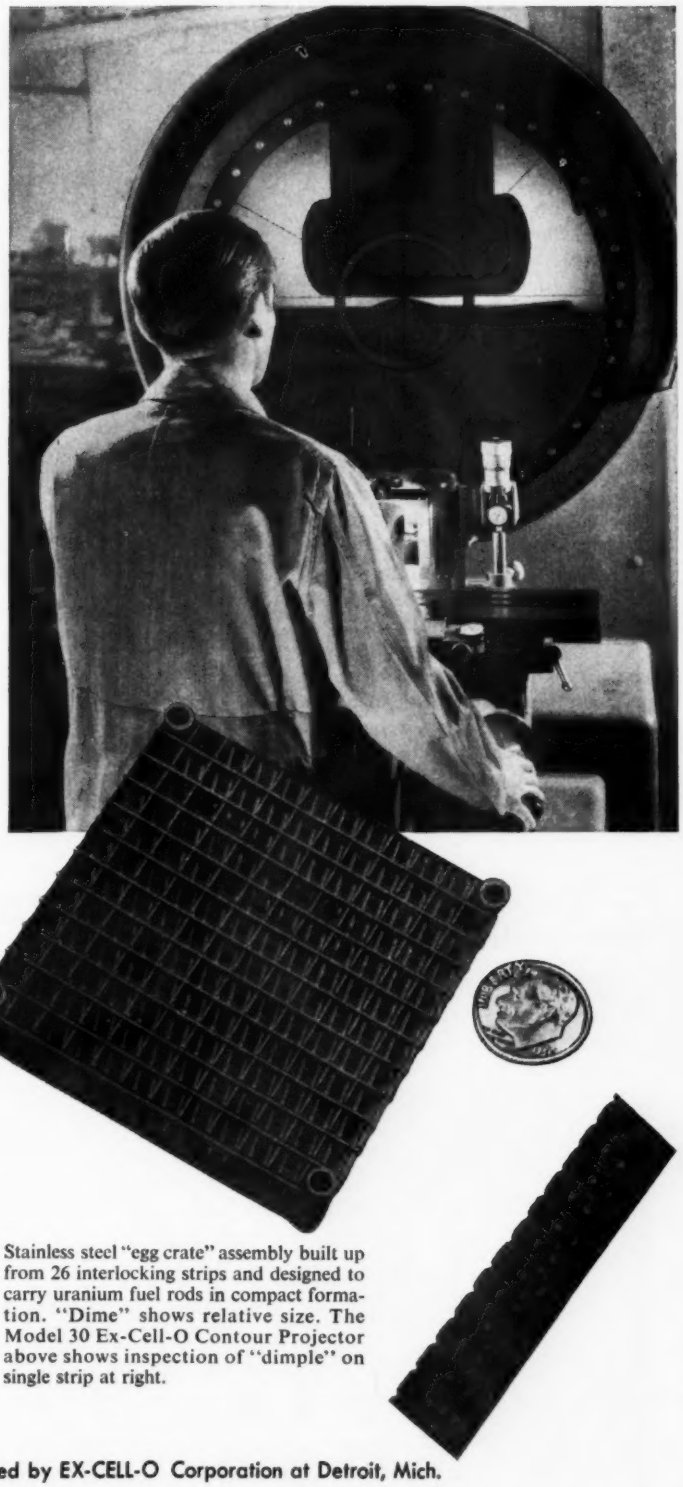
The uranium rods comprising the fuel elements in a reactor core are held vertically in "egg crate" assemblies. Each strip contains precision stamped "dimples" to provide necessary support and accurate alignment.

The problem was how to determine the maximum load that could be applied to these "dimples" before permanent set took place.

Simple with an Ex-Cell-O Model 30 Contour Projector! The workpieces were mounted in a holding fixture and stress applied in increments of one pound. Under 100X magnification the deflection in movements of .0001 inch or less was easily seen on the projector screen! With the highly accurate vertical measuring micrometer and dial indicator, standard on the Ex-Cell-O Model 30 Contour Projector, the actual deflection was measured and recorded with great precision! Successive readings were plotted up to and including the yield point.

This is not an unusual inspection application for Ex-Cell-O Contour Projectors. They are helping in hundreds of different ways to speed production and bring about greater accuracy in the fields of electronics, nuclear research, and travel in space!

If you have similar difficult inspection problems . . . if your inspection is taking too much time . . . or if you need greater accuracy . . . an Optical Gaging Products man can help you. We will gladly send you our new booklet "43 Reasons Why Ex-Cell-O Contour Projectors are the First Choice of Industry."



Stainless steel "egg crate" assembly built up from 26 interlocking strips and designed to carry uranium fuel rods in compact formation. "Dime" shows relative size. The Model 30 Ex-Cell-O Contour Projector above shows inspection of "dimple" on single strip at right.

Manufactured by EX-CELL-O Corporation at Detroit, Mich.

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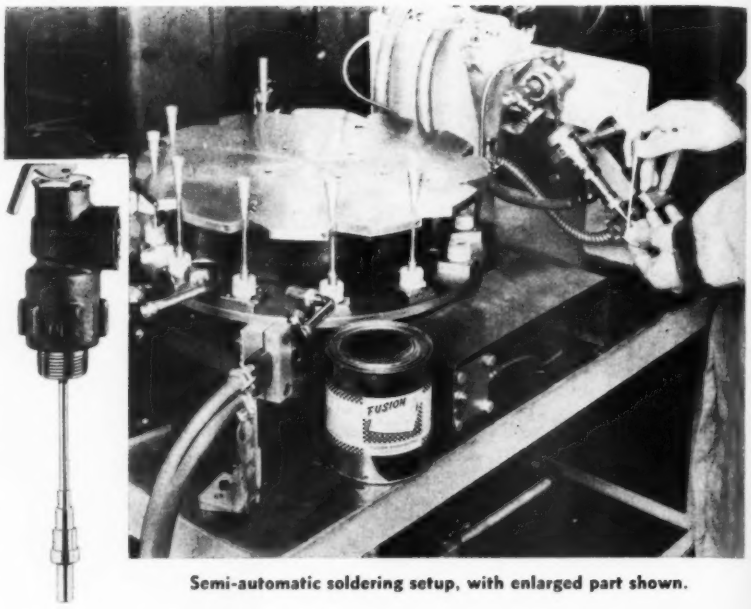
CIRCLE INFORM-A-GRAM KEY NO. 37

Speedy Soldering

The word "automation" has come to connote whirlwind transfer or indexing speeds that allow astronomical production rates. In order not to misrepresent their product, people at Fusion Engineering, Cleveland, Ohio, say their indexing machine "semi-automates" soldering line work.

The table is working for Continental Controls to speed the production soldering of an extension tube for hot water tank relief valves. It completes one soldered assembly — two soldered joints — every 10 sec. Before automatic assembly, each operator at the suburban Cleveland company turned out one assembly every 3 min.

The part requires soldering of the extension tube to the thermostat housing, and soldering of a brass insert inside the housing. These two joints are made at the same time on a soldering machine. The operator picks up a part and quickly positions it under the nozzle applicator where it receives a metered amount of solder paste.



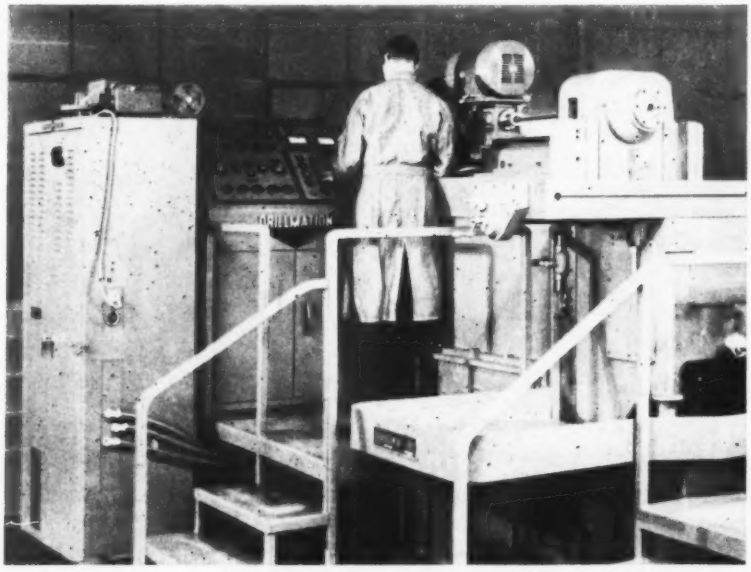
Semi-automatic soldering setup, with enlarged part shown.

The insert is then placed in the housing, and a second dab of paste is applied during insertion.

The part is then loaded into the special ceramic fixture and positioned in a slot that's spring-loaded to hold it. As the table indexes, the stem passes in front of a preheat air-gas torch, and a final heat torch, at two succeeding stations. It air cools for two stations, and is automatically ejected onto a slide.

Holes Drilled Clean, True And Right 'On the Button'

Numerical tape control and gun drilling have been combined in a single machine for fast-cycle production of precision-drilled holes, positioned to close tolerance. The machine has a standard Boremation gun-drilling power unit, capable of making precision holes up to 36″ x 2″ dia in one stroke, from the solid.



The new Boremation Electra can be operated in three ways: 1) under full automatic tape control for complex positioning and drilling, large or limited production, and even prototypes; 2) semi-automatic dial control for simple hole patterns, and small number of pieces; and 3) manual control to simplify pre-production setups.

A unique drive system permits feed rate and spindle speed to be controlled independently, and maintains constant feed rate. This assures smoother true holes and maximum tool life, even when drilling through hard spots, cross holes, or other interruptions.

For additional information, write to Drillmation Co., Inc., 6400 E. Eleven Mile Rd., Centerline, Mich., or circle Inform-A-Gram No. D2.

The Bellows Air Motor®
Makes Pneumatic Circuits
Easier to Design • Easier to Build

The Bellows Air Motor makes designing for air operation a lot easier and less costly. Its built-in directional valve, built-in speed controls, and its single air connection (which can be flexible hose) is true space-saving design—makes it fit perfectly in cramped quarters or on moving machine elements. And from the standpoint of final design, the Bellows Air Motor offers faster action, more positive control, and minimum maintenance.

The Bellows Air Motor is available in various mounting styles, in five bore sizes (1¼", 1¾", 2½", 3⅝" and 4½"), and in any stroke length. Optional built-in valves include 8-12v low voltage control, 115v JIC electric control, manual or pneumatic controls, thus giving the design engineer the widest latitude in control systems.

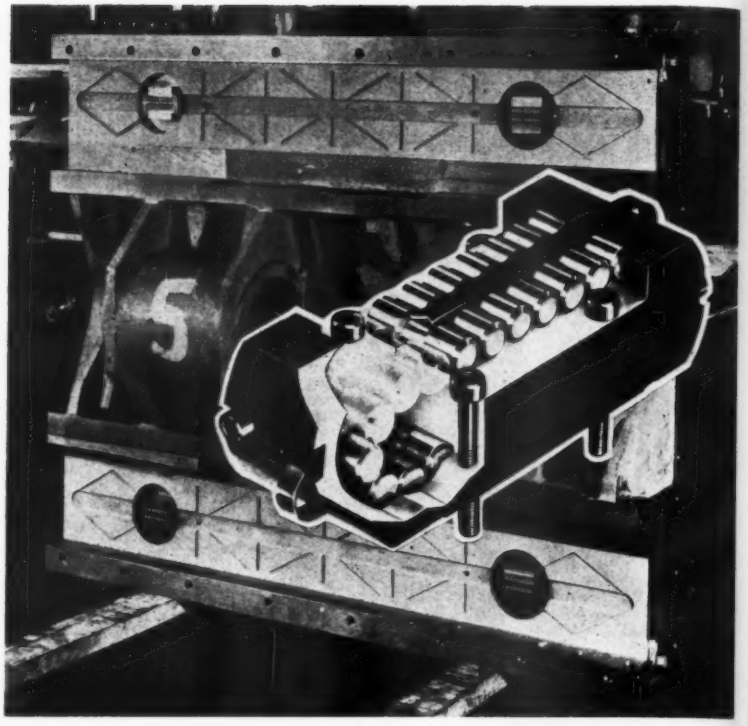
Full data on Bellows Air Motors is in Bulletin BM-25, free on request. Write Dept. TP-861. Bellows-Valvair, Akron 9, Ohio.

Bellows-Valvair
AKRON 9, OHIO
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

996-C

CIRCLE INFORM-A-GRAM KEY NO. 39

Way Bearings Increase Machine Tool Accuracy



One of the many interesting design features of Kearney & Trecker Corp.'s Milwaukee-Matic is the use of recirculating roller bearings. These solve two difficult problems for which conventional design was inadequate.

First, controlling linear positioning of a 10,000-lb vertical column through electronic scales sensitive to 0.000015 error posed a tough stick-slip problem. Repeat positioning, to be within 0.0001, required a lubrication environment that would equalize starting and running friction.

Ideal conditions were approached by distributing one-third of the load from the column to four spring-loaded Tychoway bearings, one under each corner of the shoe which carries the column. This maintains a more uniform thickness of oil on the two flat bed ways.

The second problem was solved by eight Tychoway bearings used in the spindle head saddle. The Milwaukee-Matic automatic tool turret holds up to 31 different tools, used in numerically controlled operations from small-hole drilling to heavy milling. This requires extreme sensitivity as well as rigidity in the head and feed mechanism.

Positive preload bearings reduce friction and guide the head on the upper and lower V-ways. Head alignment is held to ±0.0002. Bearings are rigidly clamped directly to the saddle and lubricated by a mist system. Extreme sensitivity permits uniform, continuous feed for tapping and drilling small holes. Tool breakage due to windup when cutting hard materials is virtually eliminated.

In the Tychoway bearing, manufactured by Scully-Jones and Co., rollers circulate through a return channel within the race. The hardened and ground machine way serves as the outer race. All working parts are made of through-hardened 52100 bearing steel and have a calculated life of 30 yrs, based on two-shift operation of the machine. Special molded wipers prevent chips from entering at the corners of the ways.

Bearings are mounted by clamps, equal to the race in length. These seat on the race rolling surface and bearing pad, permitting very high clamping forces and extreme stiffness in the assembly. A spring between the pad and frame member preloads the bearing.

Ingenious solutions to friction problems helped Kearney & Trecker capture the full potential of numerical control in this dramatic machine that combines: 1) accuracy and stability of a boring machine, 2) rigidity of a mill, and 3) sensitivity of a small drill press. A by-product advantage is a reduction in power requirements.

Further information on Tychoway bearings can be obtained from Scully-Jones and Co., 1913 S. Rockwell St., Chicago 8, or circle Inform-A-Gram No. D3.

Machine Procurement Served by Punched Cards

Industrial Machinery Data Service, Inc., of Boston is a clearing house for used machine tool information, and has an interesting service. Users list machinery they wish to sell; buyers register machines they wish to buy. The specifications of both are fed to electronic computers and matched. Then the names and addresses are sent to users whose equipment specifications are identical. User negotiates with user directly, privately and conveniently.

Cost of the service is modest. Both buyer and seller pay a registration for each listing and a percentage of the negotiated sale price when the transaction is completed. An encyclopedia of used machine tool information is contained on punch cards.

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are made up to a standard, not down to a price — yet cost no more!

***STEEL** . . . new high-carbon chromium bearing steel wears longer and thus costs much less. Demand bushings of 52-100 —it wears longer.*

***CONCENTRICITY** . . . guaranteed .0003" t.i.r. on BOTH ENDS of all standard bushings. May be ordered to .0001", if required for extra precision drilling.*

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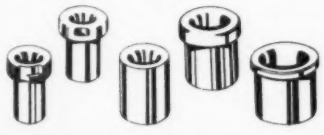

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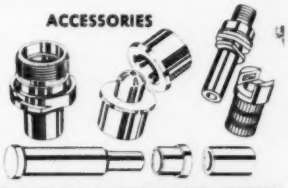
ACCESSORIES



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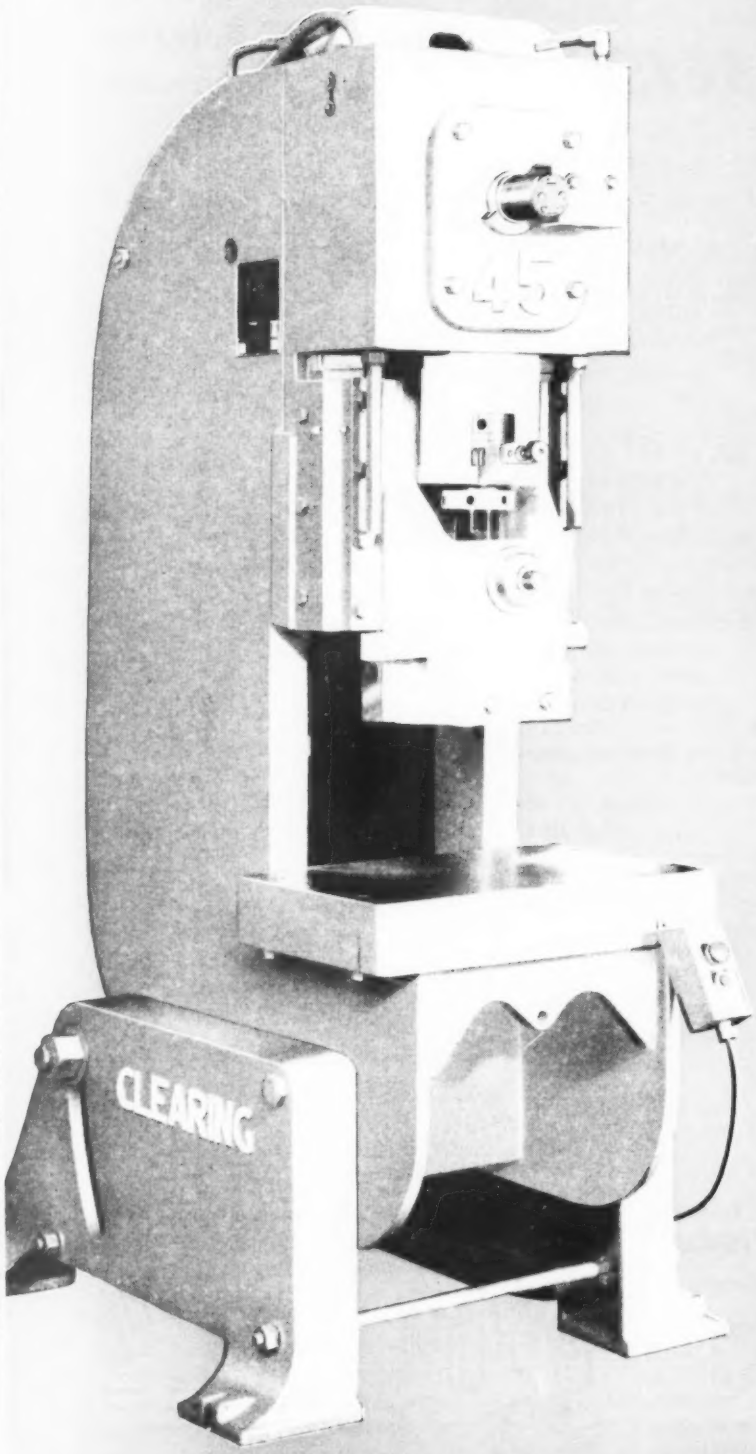
CIRCLE INFORM-A-GRAM KEY NO. 41

Here is why your next O.B.I. should be a Clearing



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In the event of a jam where the press slide is stuck on bottom, "Clearelease" makes it possible to release the jam, be back in operation in minutes.

All Steel, Enclosed Design

Clean, space-saving design improves safety. Flywheel and moving parts are completely enclosed. Rigid all steel frame resists deflection, prolongs working life of expensive dies.

Micrometer Precise Slide Adjustment

A fine adjustment setting for unusually accurate slide positioning has been newly designed. Adjustment also contains a lock which holds the slide rigidly at the desired setting.

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Your Clearing O.B.I. will have operator's control buttons and master control panel, wired in and in place when shipped. Five position selector switch is key-locked.

Get the Facts on the many carefully engineered features of Clearing's line of O.B.I. presses—22, 32, 45 and 60 tons capacity.

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Modern equipment—experienced personnel for your contract machining, welding or assembly work. Send prints or call.

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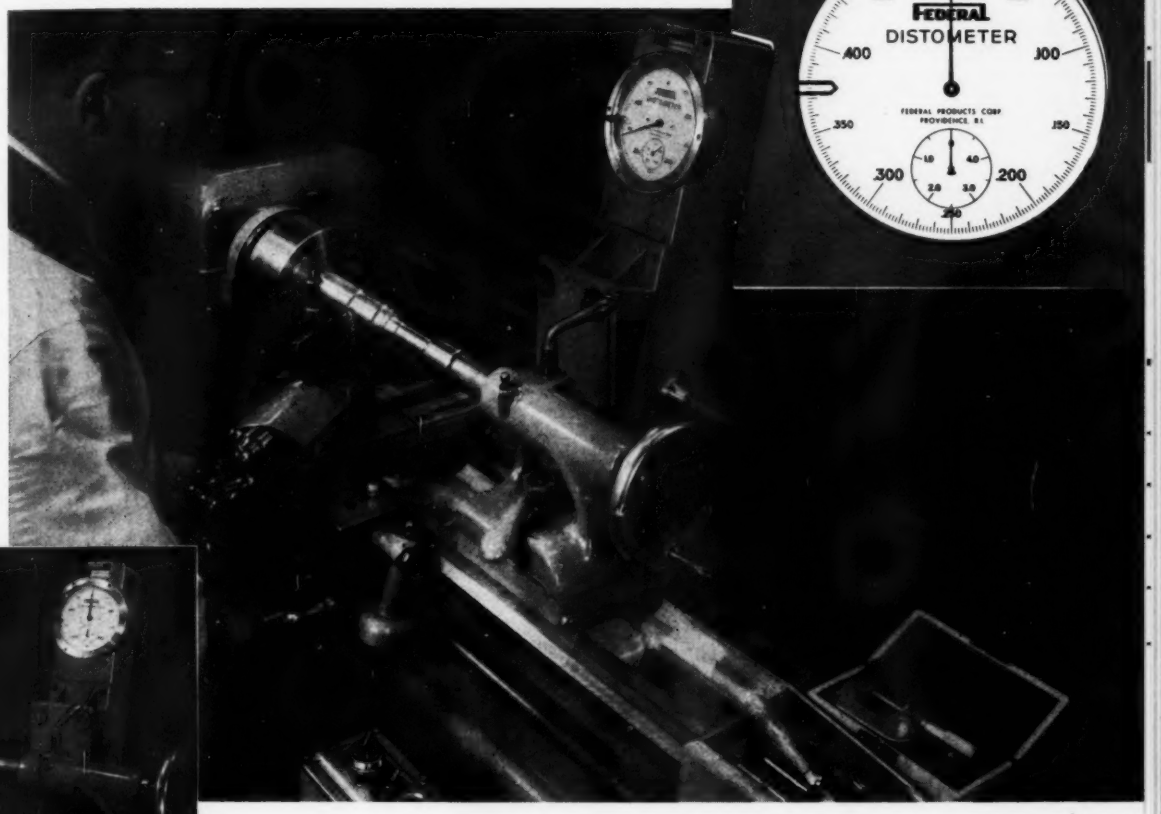
Right before your eyes...

A 27% (or more) INCREASE in LATHE PRODUCTIVITY!



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The DISTOMETER, a totally new precision instrument, greatly increases lathe output . . .

Because —

- It provides a much faster, more convenient and more reliable means of spotting tool position and measuring longitudinal cutting distance than any other available device.
- It has motorized, Push-Button Zeroing. Lets you reference instantly at any point in the carriage travel for continuous measurement to any other point.
- It puts accurate, well magnified, man-size readings in front of the operator so he can follow progress of the tool and know instantly when it has covered the required distance.
- It requires no set up, no positioning, no mastering. Ready to measure *directly* at the touch of a button.

ANY MANUALLY OPERATED LATHE . . . OLD OR NEW . . . BIG OR SMALL . . . CAN USE THE DISTOMETER PROFITABLY!
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THE Exclusive SET
Featuring REMOVABLE CAP GUIDE PINS
Spouse! Do you know that Superior removable cap guide pins permit one man to part a large die set in a matter of minutes?
Sure, Sue Perior! Just the flick of a hexagon key and the punchholder virtually floats on the guide pins . . . just like we're floating here.

Exclusive
REMOVABLE CAP GUIDE PINS

Now! Available on all Superior die sets in diameters from 1½" upward . . . AT NO EXTRA COST

Prevent die set smash-ups! End troublesome binding in parting dies! Always specify Superior die sets . . . with exclusive removable cap guide pins

You'll save time and money!

Write for exclusive features catalog — today!

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Cheshire, Connecticut

CIRCLE INFORM-A-GRAM KEY NO. 44

WHO SAVES WITH THE A-L TOOL STEEL STEELECTOR SYSTEM?

EVERYBODY DOES!

If part of your job deals with tool steel, you can save time and make your work easier by using the Allegheny Ludlum STEELECTOR System. And you will be saving your company money. Check this list to see how the STEELECTOR Program can help you:

Owner, president, vice president Reduces costs in warehousing and purchasing. Insures selection of the right tool steel—prevents misapplication and wrong heat treatment.

Operating man, superintendent, foreman, production control man Ends availability problems. Large local warehouse stocks enable you to reduce your own stocks. Consistent high quality.

Engineer, metallurgist Speeds selection of the right tool steel—saves selection time for jobs that need it.

Specifier, designer, toolroom man Assures you of the availability of the size and grade you need. Only 18 grades to consider for 96 percent of all applications.

Stockroom supervisor Saves storage space because fewer grades are needed. Ordering, paper work are reduced.

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Chapter VII - How To Calculate Rate Of Return On A Machine Tool Investment

Machine Replacement

by Baxter T. Fullerton
Mr. Fullerton is Director of Marketing Services, The Warner & Swasey Company, Cleveland, Ohio.

IN THE LAST CHAPTER we discussed the mathematical principle for finding the true rate of return of a machine tool investment, a process called **discounting.**

In that chapter we "discounted" the return from a $1000 bond with a 5% annual coupon rate for 5 yrs as follows:

1	2		3		4
Year	Money returned		Discounted at 5%		Discounted Value
1st	$50	times	.952	=	$ 47.60
2nd	50	times	.907	=	45.35
3rd	50	times	.864	=	43.20
4th	50	times	.823	=	41.15
5th	1050	times	.784	=	823.20
	$1250				$1000.50

We found that **the rate of return on an investment is the interest rate (in this case 5%) at which the money returned (column 2) discounted to the present (column 3) equals the investment's cost (total of column 4).**

From this it followed that if we can estimate the amount of money we're going to get back from a machine tool investment every year of its life, including its final trade-in value, we have a mathematical way of finding the true return.

For The Shop Manager

Longhand method in this chapter

In this chapter we're going to work out the rate of return on a typical machine tool investment. We're going to estimate the year by year earnings and then find out what discount rate will make these equal the machine's cost.

It is not necessary to work out each problem longhand as we will here. The next chapter will introduce a simple table which can be used as a short cut.

Since the table is an approximation, it will also help us keep proper perspective on this whole matter of calculations. **We should never forget that we're dealing with approximate figures at best.** Longhand calculations tend to put too much emphasis on the figures and too little emphasis on the judgment with which they should be used.

This chapter, though, explains the basic procedure from which the table is established. An understanding of this procedure **is not necessary** to use the table correctly, but **it is necessary** if you want to know how the table was derived. Many readers may want to judge how valid the answers from the table are, and that is the reason for the explanation that follows.

The explanation will necessarily be brief, and it will require careful study. I think you'll find it worthwhile.

A Replacement Problem

Here is the problem. We can buy a new machine for an installed cost of $34,000. The cost savings, or "earnings," next year will be $7,000. Present market value of the equipment being replaced is $4,000, so the net investment is $30,000. We estimate that market value of the old equipment a year from now will be $3600, a loss in value next year of $400.

We also estimate that the new machine will have a 15-yr life, and that it will be worth $5000 when we replace it 15 yrs from now.

In our short cut method, we won't need all of these "estimates." Most of them are built into the table. We do need them, though, for our longhand calculation.

The following is a recap of these conditions:

Next Year's Savings	$ 7,000
Installed Cost	
New Machine	34,000
Estimated Present Market Value Old Equipment	4,000
Net Investment	30,000
Estimated Next Year Loss In Market Value Old Equipment	400
Estimated Life New Machine	15 yrs
Estimated Worth of New Machine in 15 Yrs	5,000

Deterioration Affects Earnings

Before using the above figures, we must go back to some of the

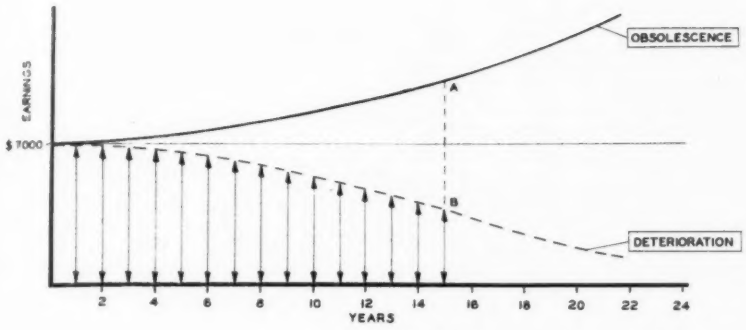


Fig. 1 Future earnings of a new machine.

basic things we learned about machine tools in the first chapter. For the moment, let's forget that our proposed investment is a replacement machine and consider it **by itself** as an investment. We know that two things are going to happen to it.

1. It will become **obsolete.** New machines of improved design will become available to do the work better and faster.
2. It will **deteriorate.** It will wear out.

We can substitute **dollars** for **production rate** and as we did in Chapt. I graph the future of the $7,000 annual earnings of our new machine. What is going to happen to these earnings? **They are going to decline, as indicated by the arrows (Fig. 1), for each of the next 15 yrs as the machine wears and becomes less efficient.**

By giving the new machine a 15-yr life in our problem we have said, in effect, that the **combination** of obsolescence and deterioration (Line A-B Fig. 1) will make it economically replaceable at that time. Obsolescence affects the length of life of our machine; deterioration affects both the length of life and the earnings during its life as the machine wears.

Old Equipment's Loss In Value Must Be Accounted For

One final step is necessary before we can make our calculation. When our investment is a replacement machine, rather than a new project, the next year loss in market value of the old equipment must be taken into account.

Why? Because we're really comparing the over-all costs of owning the new machine with the costs of continuing to own the old equipment. We're going to take into account the future decline in value of our new machine, and we must also consider the continuing decline in value of the old if we keep it rather than buy the new machine.

Here is how to figure this:

Fig. 2 shows our new machine replacing an old one at point A. The old one happens to be 15 yrs old, and the combination of obsolescence and deterioration on the old equipment, Line AB, gives our new machine earnings of $7000.

To allow for the course of future earnings, though, we need a base against which to measure the declining earnings of the new machine. We need to straighten out the old machine's decline at "B," as in Fig. 3, so that we can make the same measurement as previously discussed for Fig. 1. Somehow, we have to "freeze" the physical condition of the old machine so that it doesn't deteriorate anymore!

This can be done only theoretically. The old equipment is now 15 yrs old, and our problem states that it's worth $4000 now and will be worth $3600 next year. Theoretically, if we don't buy the new machine, we can sell the old one **next year** when it's 16 yrs old for $3600 and buy a 15-yr old machine of the same model for $4000. Then we can sell **that** machine after one year and for $400 more get another 15-yr old machine. For a capital

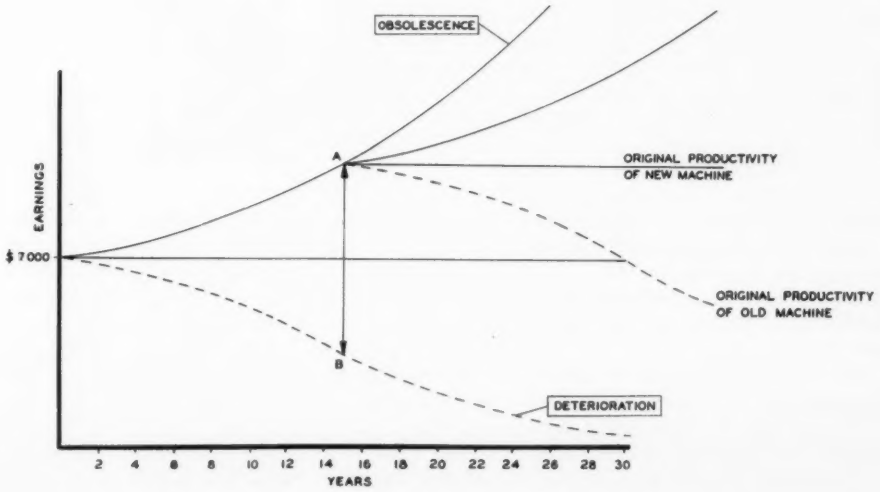


Fig. 2 New machine to replace an old one at point A, and earn $7000.

cost of $400 per year we can keep old equipment indefinitely.

We needn't dwell on the obvious practical difficulties of trying any such scheme, because it's not necessary to try it. What we now have is a mathematical choice. Either we can buy the new machine or we can retain the old machine **and keep it in its present condition** for a cost of $400 per year. This becomes an "either/or" choice, so if we buy the new machine, we don't have to spend $400 per year to freeze the old one, and the **$400 is credited annually to the earnings of the new machine.**

This gives us a base against which to measure the future declining earnings of the new machine.

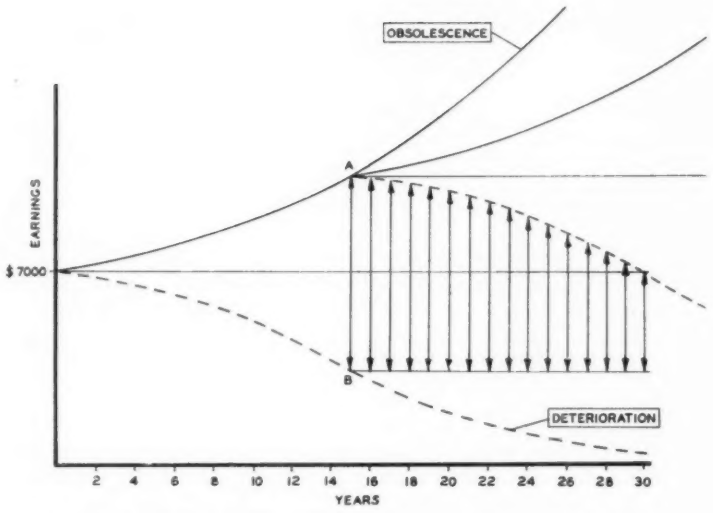


Fig. 3 Deterioration curve of old machine straightened out for measurement purposes.

Working the Problem

We now have all the figures we need to find out how much we get back from our investment on a year-by-year basis. We work out our problem as follows:

For year one, put down the annual savings.

Year	Annual Saving
1	$7000

To find gross earnings, add to this the credit we get for not having to freeze the condition of the old equipment.

Year	Annual Saving	"Freeze Credit"	Gross Earnings
1	$7000	$400	$7400

An "After Tax" Answer

We want our answer to be **after taxes** so that we can compare it with investments that don't have the peculiar tax benefits of machine tools. The tax laws recognize that machine tools are a wasting asset, and we can recover the cost of our investment tax free.

For tax purposes we can "depreciate" our new machine from $34,000, its original cost, to $5,000, its estimated worth 15 yrs from now. We are allowed $29,000 of income on which we won't have to pay taxes.

For this problem, let's assume that our accountants will depreciate this machine over the full 15 yrs of its life, and use the "sum-of-the-digits" accelerated depreciation method. The **method** of depreciation is a matter for accountants, not shop people, so it is not necessary to explain it here.

Suffice it to say that by any method we can deduct $29,000 from our taxable income, and that accelerated depreciation is in common use.

With this depreciation method, our first year deduction is $3625. We put it into our calculation,

Year	Annual Saving	"Freeze Credit"	Gross Earnings	Depreciation
1	$7000	$400	$7400	$3625

Subtract it from "gross earnings" to get taxable earnings,

Year	Annual Saving	"Freeze Credit"	Gross Earnings	Depreci-ation	Taxable Earnings
1	$7000	$400	$7400	$3625	$3775

Divide "taxable earnings" by two to find the amount of tax at a 50% tax rate (52% for most companies)

Year	Annual Saving	"Freeze Credit"	Gross Earnings	Depreci-ation	Taxable Earnings	Tax
1	$7000	$400	$7400	$3625	$3775	$1888

And subtract "tax" from "gross earnings" to obtain after tax net earnings.

Year	Annual Saving	"Freeze Credit"	Gross Earnings	Depreci-ation	Taxable Earnings	Tax	Net Earnings
1	$7000	$400	$7400	$3625	$3775	$1888	$5512

Fig. 4 shows the entire problem worked out similarly for each of the 15 years of the new machine's life.

The "annual savings" are reduced each year because of the effect of deterioration. You'll notice that there's a substantial reduction. You needn't agree or disagree with these figures at this point, since we're just working out a sample problem and you can substitute your own estimate if you wish. They will be discussed again in the next chapter.

The estimated market value of $5000 at the end of 15 yrs is added as a credit to the 15th year. That's money we can get back then, if we want it.

Finally, the column of net earnings is **discounted,** and by cut and

Year	Annual Savings	"Freeze Credit"	Gross Earnings	Depreciation	Taxable Earnings	Tax	Net Earnings	Add'l Credit	Discounted at 14%	Discounted Value
1	$7000	$400	$7400	$3625	$3775	$1888	$5512		.88	$ 4851
2	6925	400	7325	3383	3942	1971	5354		.77	4123
3	6845	400	7245	3142	4103	2052	5193		.68	3531
4	6760	400	7160	2900	4260	2130	5030		.59	2968
5	6670	400	7070	2658	4412	2206	4864		.52	2529
6	6575	400	6975	2417	4558	2279	4696		.46	2160
7	6470	400	6870	2175	4695	2348	4522		.40	1809
8	6355	400	6755	1933	4822	2411	4344		.35	1520
9	6230	400	6630	1692	4938	2469	4161		.31	1290
10	6090	400	6490	1450	5040	2520	3970		.27	1072
11	5935	400	6335	1208	5127	2564	3771		.24	905
12	5765	400	6165	967	5198	2599	3566		.21	749
13	5560	400	5960	725	5235	2618	3342		.18	602
14	5325	400	5725	483	5242	2621	3104		.16	497
15	5020	400	5420	242	5178	2589	2831	5000	.14	1026
										$29,632

Fig. 4 Longhand calculation for finding rate of return.

try we find that discounting at 14% makes the money returned add up very close to the net cost of the machine. (The actual answer is 13.75%). Here, **the rate of return on an investment is the interest rate (14%) at which the money returned ("Net earnings" column) discounted to the present ("Discounted value" column) equals the investment's cost ($30,000).**

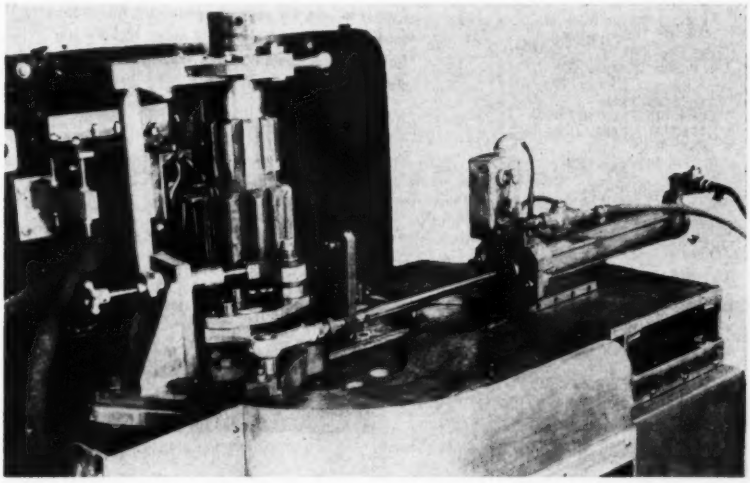
How Good Is 14%?

The next question is, "Should we buy the new machine on this return?" The answer will usually be "Yes." It depends on many factors such as investment risk, on other investment opportunities you may have, and on your company's financial position.

This is after tax return, equivalent to a 28% **pre-tax return** on other investments. Also, it makes all necessary allowances for machine obsolescence, deterioration, life of the machine, etc.

This is a true rate of return that can be compared with any other investment. On this basis, and subject to the above qualifications, I think most treasurers will agree it's a very handsome one! ■

Fixture Allows Automatic Gear Teeth Hardening



Hardening of gear and pinion teeth is speeded by a new fixture which handles both heating and quenching in an automatic cycle. Only loading and take-off are done by the operator.

The air-operated fixture is made by Induction Heating Corp., Brooklyn, N.Y., and can harden any pinion or gear up to 20" dia and with a 6" maximum face. No extra time is needed for quenching, since it has been made part of the indexing cycle, just after the tooth has been heated.

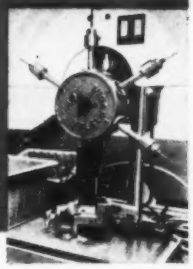
The operator first selects the proper inter-changeable water-cooled work coil. With the correct adaptors in place, the work is set into the lower bearing. The upper bearing clamp is closed, and the "start" button begins an automatically timed cycle, pre-set to accommodate the number of teeth to be hardened. An air cylinder then indexes fixture and work into the heating zone.

After the heat cycle, the cylinder retracts, and a ground-insulated pawl selects the next tooth for heating. The pinion rotates one tooth and re-enters the heat zone, while the previously heated tooth enters the quenching area. Each time the air cylinder retracts, the action trips a limit switch, which resets the timer for a new-quench cycle for each tooth. In turn, this action reverses the air cylinder stroke.

Burgmaster BENCH MODEL TURRET DRILL

Saves 89% of Equipment Cost... Increases Production 120% for Prest-o-matic

Pays for itself in Four Weeks- Saves Handling Time, Operator Fatigue and Valuable Floor Space



JOB FACTS

Company: Prest-O-Matic Company

Machine: Burgmaster Bench Model Turret Drill

Part: Die Cast Aluminum Valve Body

Lot Size: Continuous — 220 per day

Holding: Special Fixture

Special Attachments: 2 Burgmaster "3000" Tapping Heads

Production Rate:

Former Method: 4 Single Spindle Drills

Former Production: Valve Bodies — drill 8 — tap 3 holes — 100 per day

Present Method: Burgmaster Bench Model Turret Drill

Present Production: Valve Bodies — drill 8 — tap 3 holes — 220 per day

Production Increase: 120%

Other Advantages: Less handling time, less operator fatigue, 75% less floor space

When the Prest-O-Matic Company, Santa Ana, California tooled up to drill 8 holes and tap 3 in their die-cast aluminum valve bodies, they selected a Burgmaster Bench Model Turret Drill to save 89% of original equipment cost, and increase production 120% over the output of 4 single spindle drill machines. Savings in production costs paid for the Burgmaster Bench Model in just 4 weeks of operation. Additional savings reported by Prest-O-Matic include less handling time, less operator fatigue, and a 75% saving in floor space.

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Tooling Innovation Simplifies Turning

A turning operation, problematical because of part configuration, has been simplified by a tooling innovation at the East Moline Works of International Harvester Co.

The part is the cast iron for a corn picker machine. It requires severe interrupted cuts on the OD, has an average hardness of 225 Bhn, and is long in relation to the amount of cutting required.

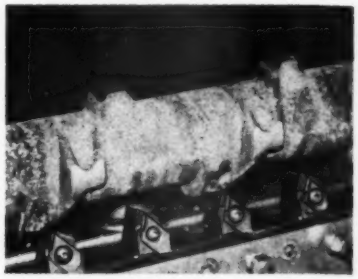


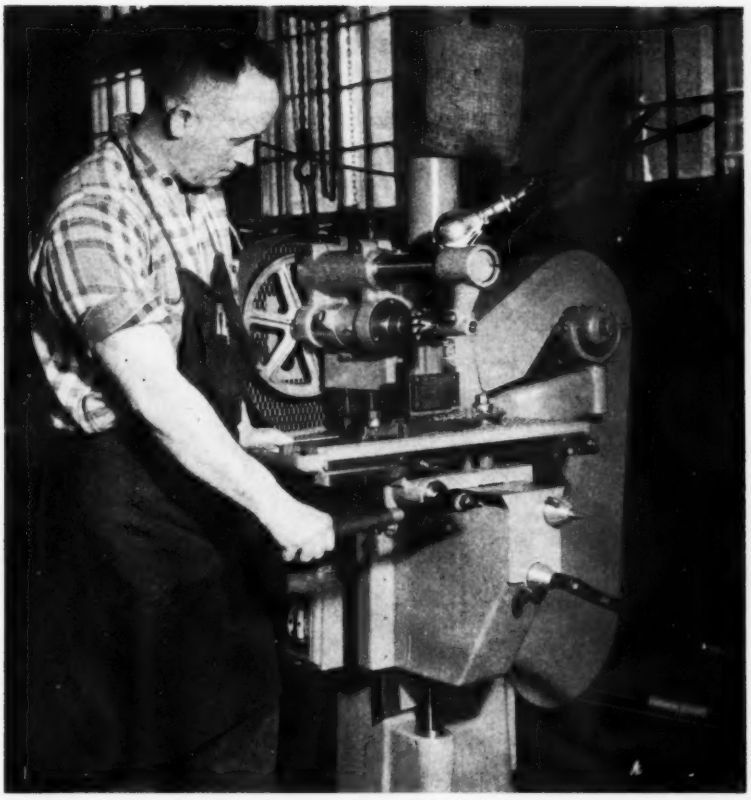
Fig. 1 Projections on rolls dictate a severe interrupted cut.

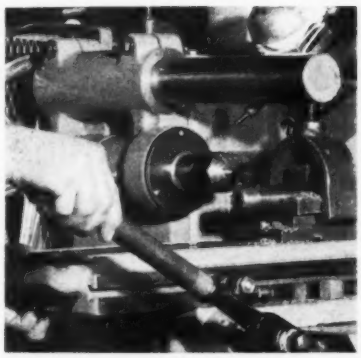
Because of the many projections and the severity of the interrupted cut, Fig. 1, an engineer recommended the use of multiple tools—with successive tools taken identical cuts—and consideration of the roll as two parts. By designing tooling this way, machining time was minimized, and tool life extended. Two tool blocks are used, each holding five Wessonmetal general purpose cast iron grade throw-away inserts.

Cutting speed is 530 sfpm, with feed of 0.0097 ipr and depth of cut of 3/32" per insert. Each tool block feeds 3 9/16". About 60 rolls are turned with each set of 10 inserts.

Fig. 2 Tool blocks are mounted so that inserts cut directly below the workpiece.

Pump Specialists Mill Keyways





Low initial cost, simplicity, accuracy and flexibility were all factors of careful consideration when the time came for modernization of the keywaying operations of the numerous pumps made by Goulds Pumps, Inc., Seneca Falls, N.Y. Since their pumps are so varied, the production of shaft keyways demands unusual versatility.

Small and compact, the No. 1, U. S. Mill, product of the U. S. Burke Machine Tool Co., Cincinnati, Ohio, offered low initial cost, yet provided all the facilities necessary to control size on their many different keyways at Goulds. Engineers also liked the ease of operation and the fact that the head feeds up and down for simplified milling of Woodruff keys.

The Mill is utilized for milling both the keyways and the radius ends of the keys themselves. To mill keyways, shafts are laid on a "V" block and held down with a sliding clamp. Hand feed is used, with the cutter mounted in the spindle head of the unit.

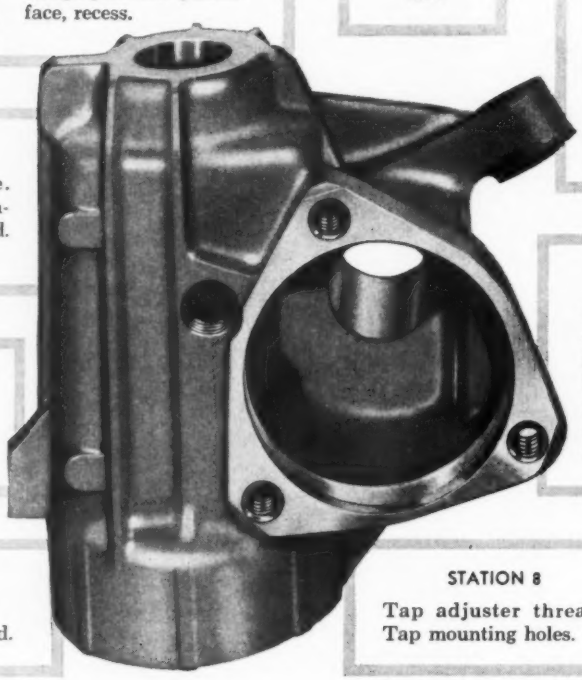
To mill keys, they are inserted on end into a fixture holding 10 or 12 keys at a time, depending on size. A concave radius cutter mounted on an arbor is used to radius one end of all the keys in one pass. Then they are reversed and the radius operation on the other end is milled. Hand feed is again used, with spindle speeds of from 160 to 246 rpm. Some of the metals milled for keyways and keys are stainless steel, cold rolled steel and monel.

The machine is of simple heavy duty construction, without complicated gear trains and consequently requires only preventative maintenance. Easy operation is provided also by the simplified design in that the six speed changes can be made quickly by V-belts.

Other low cost machining is possible besides keywaying; but sawing, slotting, squaring, cutoff, short-run splining and light slab milling are all possible.

This installation is just one of many where hand feed milling machines have proven desirable for production throughout industry for work on all types of materials.

The machine is equipped with air-hydraulic feed for semi-automatic use when desired. It is said to achieve excellent results with automatic table and head feed. It has been used in this way for complete automatic milling of germanium for transistors, for semi-automatic stake notching of shells on a production basis and for low-cost high production milling of automotive parts. ■



STATION 1
Load and clamp. Unclamp and unload.

STATION 2
Rough bore and chamfer cover hole. Rough bore Shaft Hole.

STATION 3
Generate cover face. Rough bore and chamfer for adjuster thread. Rough bore pilot dia.

STATION 4
Semi-finish bore shaft hole and cover bore. Rough generate cylinder face, recess.

STATION 5
Idle.

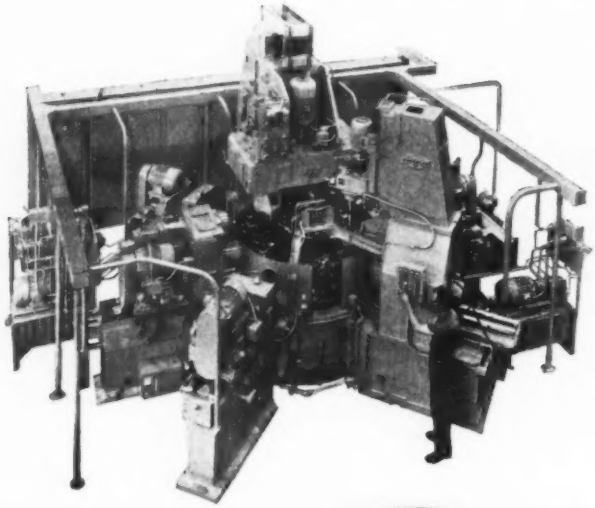
STATION 6
Drill and countersink mounting holes. Semi-finish bore pilot hole, rough bore and chamfer bearing cup and seal diameters.

STATION 7
Finish bore cover and shaft holes. Finish bump face side cover. Finish bore adjuster thread, pilot, bearing cup and seal diameters. Bump face cylinder.

STATION 8
Tap adjuster thread. Tap mounting holes.

153 Aluminum Steering Gear Housings per hour

automatically processed on this GREENLEE Machine



This Greenlee 8-Station Horizontal and Vertical Spindle Machine is establishing some excellent performance records for a leading automotive manufacturer. The 52 inch table carries 8 work fixtures. Each has power clamping. To insure rigidity and accuracy, the table is clamped hydraulically metal to metal. Indexing is fully automatic. Cycle time is 23.5 seconds. Like all Greenlee machines it's built for long, continuous service. Can be modified economically if desired. Have our representative give you complete information.

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9	20	44	82	552	591	612	641	663	742	792	
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C3	C9	C15	C21	C27	C33	P3	P9	P15	P21	P27	
C4	C10	C16	C22	C28	D1	P4	P10	P16	P22	P28	
C5	C11	C17	C23	C29	D2	P5	P11	P17	P23	P29	
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11	22	52	84	571	593	614	643	682	762	801	

EDITORIAL ITEMS

C1	C7	C13	C19	C25	C31	P1	P7	P13	P19	P25	P31
C2	C8	C14	C20	C26	C32	P2	P8	P14	P20	P26	S30
C3	C9	C15	C21	C27	C33	P3	P9	P15	P21	P27	
C4	C10	C16	C22	C28	D1	P4	P10	P16	P22	P28	
C5	C11	C17	C23	C29	D2	P5	P11	P17	P23	P29	
C6	C12	C18	C24	C30	D3	P6	P12	P18	P24	P30	

Which article in this issue interested you most? _____

FOR YOUR CONVENIENCE

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NEW

KENDEX* Profiling Tool

...positively locked insert plus an adjustable chipbreaker

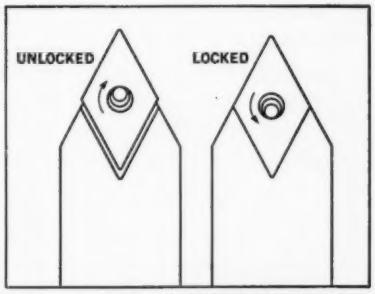
Now in one profiling tool you can get *both* of the latest design improvements. Another "first" from Kennametal Inc., the new Kendex Profiling Tool (A) securely holds inserts during normal cutting, back facing or contouring, and (B) permits a wide range of chipbreaker adjustment by simply turning a dial wheel.

The main design feature of this dramatically new Kendex tool is the eccentric pin that holds the insert securely in place. Positioned through a hole in the insert, this pin, plus the top clamp, positively eliminates any movement of the insert.

Just by turning the threaded dial wheel, the "Dial-A-Breaker" provides a wide range of adjustment of chipbreaker land width. Still another feature is the spring plunger that raises the chipbreaker when the clamp is released, making it easier to change, index or invert the insert.

Performance-proved on job after job over a period of months, the new Kendex Profiling Tool is now available from stock in three holder styles. The diamond shaped insert has a 55° nose angle, suitable for practically any profiling job. It is set in the holder at 5° negative side and back rake to provide four accurately indexable cutting points.

Get the complete story on this new profiling tool. Call your Kennametal Representative or write direct to KENNAMETAL INC., Latrobe, Penna.



As the wrench is turned it first rotates the eccentric pin, forcing the insert back and locking it against two walls of the recess. Further rotation of the wrench locks the eccentric pin so that it cannot loosen during use.

*Trademark 33599

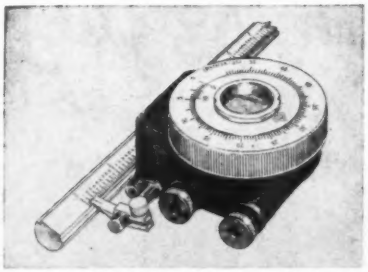
INDUSTRY AND KENNAMETAL ...Partners in Progress

CIRCLE INFORM-A-GRAM KEY NO. 53

T&P Product News

Ever-True Reader

Measuring of hole centers, locating of points and compensating for machine setting errors can be done efficiently with Ever-True. The new optical micrometer reader is designed for continuous production or short runs. It has a large bright screen for direct reading to 0.0001. Reading scale can be set at any zero reference, or any starting point to eliminate additional mathematics. The unit scans SIP graduated scales attached to a machine table. The scales are accurate



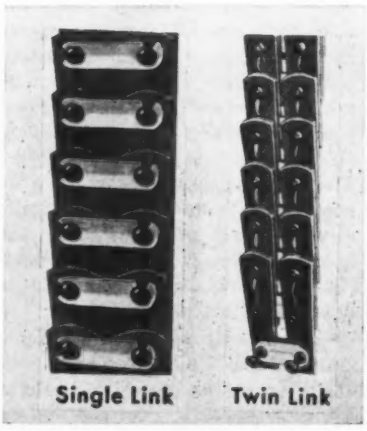
0.0002 in any 40″ of length and come in one-piece lengths up to 15 ft. Write Edgcomb Engineering & Engraving Co., 1105 N. Hollywood Way, Burbank, Calif., or circle Inform-A-Gram No. P2.

Drilling and Tapping

Dril-King is a completely self-contained, compact drilling and tapping machine equipped with a vertical feed work table that brings the work up to the head instead of vice versa. The standard unit is 66″ high including base. It features 12 spindle drivers and obtains center distances down to ⅜″ minimum. Closer center distances are available with variations of the basic spindles. Work area of the standard model is 6 x 8¼″. Jarvis Corp. Machine Tool and Attachments Subsidiary, Middletown, Conn., offers air feeds and cluster plates among the optional equipment. Write them, or mark Inform-A-Gram No. P3.

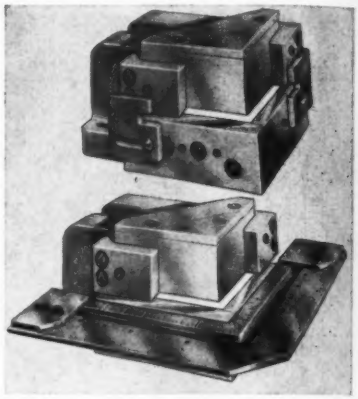
Adjustable Belting

Adjusta-Link, a new belting, fits all V to V drives and is interchangeable with all endless moulded and wood block belts. It is sold by the foot to make any size belt desired from the same roll. It is from ⅞ to 4″ wide. The belting is pre-stretched and tested for perfect rigidity and minimum vibration. It is also heat and oil resistant. Longitudinal flexibility permits easy flexing around small diameter pulleys. Write Lovejoy Flexible Coupling Co., Dept. TP-3, 4979 West Lake Street, Chicago 44, Ill., or mark No. P1.



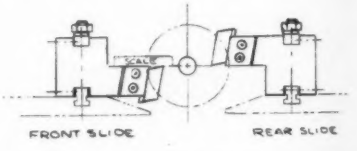
Easy Corner Notching

A new corner notching unit insures burr-free notching of parts. Secret of its success is a cast-to-shape tool steel punch that eliminates the need for a cap. The no-cap feature allows for V notching or cropping of angles and corner notching of flat sheets. The right and left hand models are stock items at Tool Products Corp., North Tonawanda, N.Y. Write them or check Inform-A-Gram No. P4.



Dovetail Tool

Grip-Lock D.F.T., a new toolholder with a 10° front rake, fits front and rear slide for single-spindle automatic screw machines. The dovetail form tool is said to give improved finish on production parts. It's quick to set up and



easily returnable to the screw machine after sharpening. A scale can be used to align the cutting edge with the centerline of the production part. Downtime is kept to a minimum, since as little as 0.010 is adequate for sharpening. Dovetail tool form blanks can be ground to specific forms by the user. Hardened or soft ground cutters are available in sizes ¾ x ¾, ¾ x 1, and ⅞ x ⅞″. The blanks and finished cutters are available in Dynamvan, Vasco-Supreme, CT-15, Circle-C, and other materials. Write Royal Machine & Tool Corp., 31 Deming Rd., Berlin, Conn., or Inform-A-Gram No. P5.

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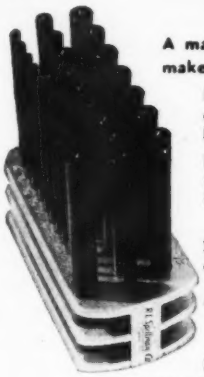

A matched set of transfer punches for toolmakers, machinists and tool cribs.

Used for transferring location of threaded, drilled and reamed holes, slugs, blanks, etc.

Precision made of finest tool steel carefully heat treated and tempered for long life. .0025 undersize to facilitate use—black oxide finish.

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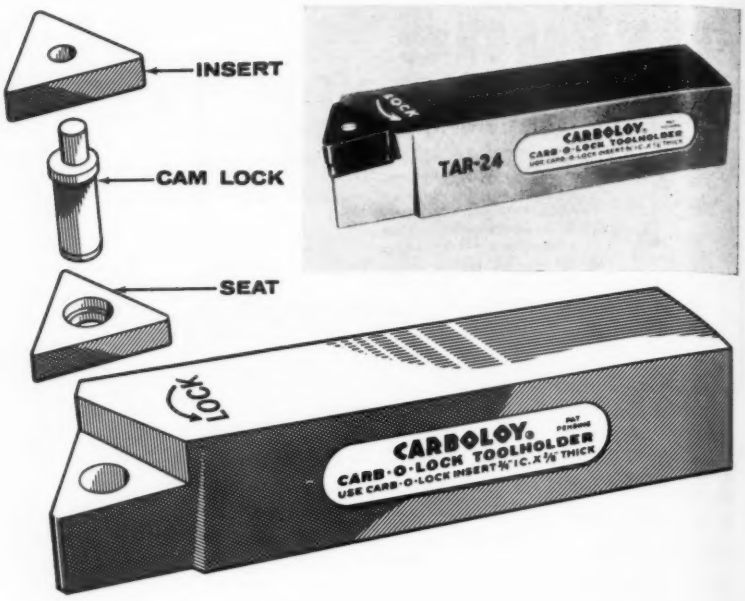
CIRCLE INFORM-A-GRAM KEY NO. 553

Product News

Quick Change Toolholder



They cast aside all pre-conceived notions about toolholders and came up with Carb-O-Lock. "The result is revolutionary, probably the most important advance in the history of disposable carbide tooling," says Henry F. DeLong, General Manager Metallurgical Products Dept., General Electric Co., Detroit.

The basic principle of the new Carb-O-Lock toolholder is a cam action lock. The insert is engaged by an eccentric on the central cam pin. This results in a positive lock that's unshakeable by vibration or pressure of the cut. The conventional "club head" and clamp have been eliminated, and the holder and insert are as compact as a brazed tool. With only three parts plus insert, the holder is remarkably simple compared to others with as many as 12 parts. Only an Allen wrench is needed for insert changes. Carb-O-Lock is offered in 15 styles and 124 sizes for triangular and square inserts. Shank sizes range from ½ to 2″ square. The smaller sizes may be expected to replace brazed tooling in many applications. The Carb-O-Lock toolholder-insert combination is said to reduce cutting edge costs up to 40%.

Write the makers, or check Inform-A-Gram No. P7.

Heavy Duty Hooks

J & J safety lift hooks have efficiently handled multi-ton dies and other heavy duty jobs for the past 15 yrs. The hooks are used with overhead cranes. A new swivel feature permits 360° maneuverability of dies while the attaching bolt stays tight. Conventional hooks demand loosening of bolts for swiveling. The hooks are made of one-piece drop forgings of chrome nickel-steel, oil quenched and drawn for maximum toughness. Bolts are of chrome-vanadium steel. The hooks are manufactured by Mentor Products, Inc., Mentor, Ohio and come in 3, 6, 9 and 15-ton capacities. Write the maker, or circle Inform-A-Gram No. P6.

Cleaning Indicator

A new air filter for 2″ lines allows the operator to see at a glance whether the filter needs cleaning. Pressure drop is indicated on the two air gages, sediment or excess water can be seen in the transparent plastic bowl. To clean the element one removes only a hand ring and one nut. In case sediment clogs the automatic dumping device, pressing a button will cause it to be cleaned by full line pressure. Then the trap mechanism returns to full automatic operation. Working pressure of the 26 lb unit is 125 lbs. It's

available for 2″ pipe lines and designed for full 3″ capacity. More from Techmatic Specialties, Inc., Royal Oak, Mich., or Inform-A-Gram No. P8.

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A Cost Saving

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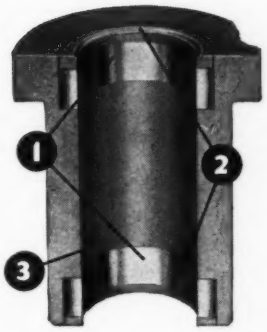

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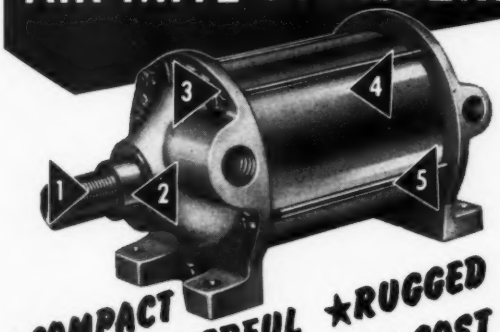

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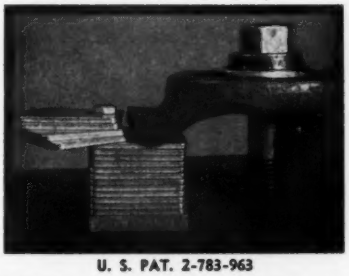
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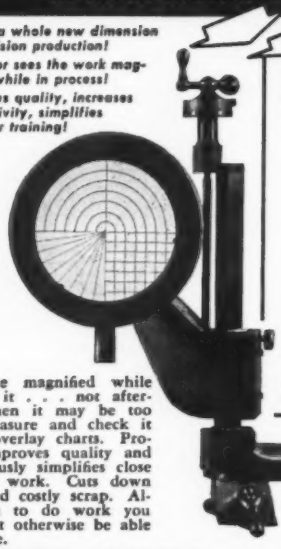

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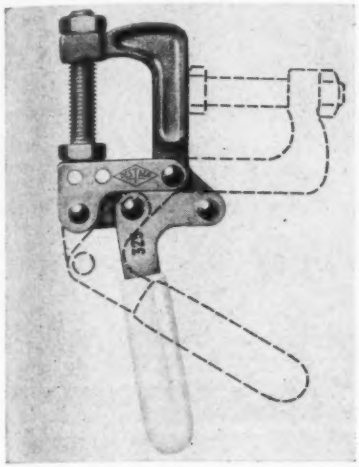
Product News

Toggle Clamps

Model 325, a new hold-down medium duty toggle clamp, is designed especially for attachment to the sides of conveyors or containers and the edges of lids or covers. The new clamp weighs only 15 oz, but has a holding pressure of 800 lbs. Insertion and removal of work is simple due to the 90°



jaw opening. The safety-ease plastic handle moves 50° for easy, one-hand operation. More from Detroit Stamping Co., 330 Midland Ave., Detroit 3, Mich., or Inform-A-Gram No. P9.

Stub Reamers

A new short length flute design on stub reamers assures clean holes, prolonged tool life, eliminates chatter and bellmouth holes. It's credited with tolerances to 0.0002. HLB Economy Stub Reamer is available in 89 standard finished sizes from 1/16 to 1", from stocks at Lavalle & Ide, Grape Street, Chicopee, Mass. The reamers allow for savings in steel and stock removal, due to smaller shank and streamlined shank diameter. Pin holes are eliminated since most users do not need them. Reamers with pin holes can be ordered. Contact the makers, or circle No. P10.

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The fast, easy operating PSC Disconnects permit quick, economical making and changing set-ups. Less down-time—more production time.

Ask for BULLETIN 1475 and get complete details and engineering data on PSC Disconnects.

PERFECTING SERVICE CO.

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Baltimore · Buffalo · Chicago · Cleveland · Camden · Los Angeles · New York · Providence · Montreal · Toronto · Canada

CIRCLE INFORM-A-GRAM KEY NO. 593

LIFTING DEVICES
for
FAST • SAFE • BETTER
Material Handling
of
• SHEETS
• COILS • BOXES
• MOLDS
• DRUMS • PALLETS
400 MODELS
H. L. BUSHMAN CO
100-A W. Central Ave
Roselle, Illinois

CIRCLE INFORM-A-GRAM KEY NO. 601

MINIATURE
DRILL BUSHINGS
Hole Sizes—No. 80 to 3/32"
O.D. 3/32" to 13/64"
Lengths ⅛" to 3"
.0002 Tolerance on I.D.
O.D., and Concentricity
Specials to your specifications
WRITE FOR CATALOG
PREBCO BUSHING CO.
14714 East Arrow Hwy., Baldwin Park, Cal

CIRCLE INFORM-A-GRAM KEY NO. 602

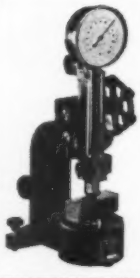
CAM milling/JIG boring

A SPECIALIZED CAM MILLING SERVICE, JIG BORING, SPOT WELDING, CONTRACT PRODUCTION
EXPERIMENTAL DEVELOPMENT
CAM CALCULATING SERVICE
Write for catalog 55-C
EISLER ENGINEERING CO., INC.
Chas. Eisler, Jr., President
732 So. 13th St
Newark 3, N. J.

CIRCLE INFORM-A-GRAM KEY NO. 603

DRILL THESE HOLES
BY A QUICK, EASY, INEXPENSIVE METHOD
Your business letterhead will bring literature
WATTS BROS. TOOL WORKS
Wilmerding, Penna.

CIRCLE INFORM-A-GRAM KEY NO. 604

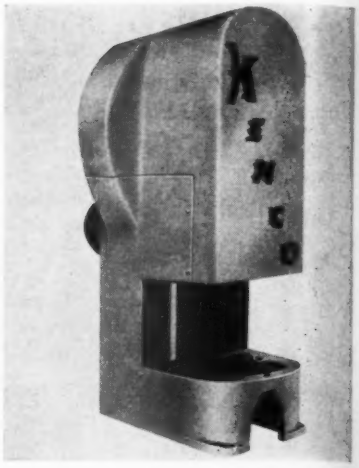


HARDNESS TESTING
has been done with the SCLEROSCOPE
Since 1907
•
THE SHORE INSTRUMENT & MFG. CO., Inc.
90-35 Van Wyck Expressway
Jamaica 35, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 605

Product News

New Slant Punch Press

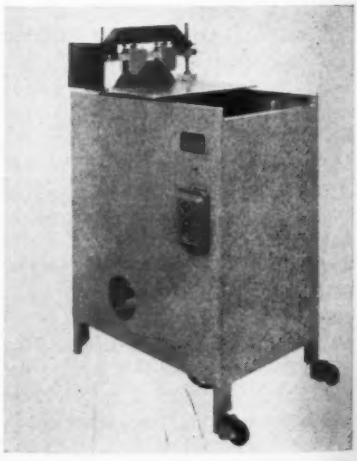


Kompac punch presses feature a shorter crankshaft and fewer moving parts. Resulting reduced friction cuts starting and stopping load 75% with less wear of parts. The frame is high strength, multiple-ribbed 60,000 psi sorbitic casting. Exclusive features are a totally enclosed yet easily accessible flywheel, crankshaft, connection rod and ram, rear-mounted flywheel, and a new self-contained interchangeable power transmission unit which is available in various stroke lengths from ¼ to 2". Write Kenco Mfg. Co., 5211 Telegraph Rd., Los Angeles 22, Calif., or mark Inform-A-Gram No. P12.

At Top Production Speeds

The Matthews Model 5627 rotary spot printer enables galvanized sheet producers and manufacturers of other flat products to control the position and number of trade-marks or imprints desired per sheet. Also, it prints at top line speeds. The location and number of imprints is governed by a unique electronic control system. Mechanically driven, only the printing die comes in contact with the sheet surface. This eliminates the danger of surface marring or distortion on even the lightest gage sheets. Push-button controlled, the unit can "spot" print or continuous print. The advanced rotary spot printer is designed and built by Jas. H. Matthews & Co., 3942 Forbes Ave., Pittsburgh 13, Pa. For further information circle Inform-A-Gram No. P13.

Traveling Saw



Continuous production cutting at 60 fpm of non-ferrous roll-formed or extruded shapes, and material fed from automated stock racks is the forte of PS 14 automatic traveling table cut-off saw. The unit is equipped with a 14" circular blade and powered by a 1-hp motor. It cuts shapes up to 4⅞", and flat material to 12" wide with ⅛" accuracy. The saw cycles automatically for 30 cuts/min at predetermined lengths in ⅛" thick material. Heavier material can be cut at slower feeding and cycling. Write The Vern Emery Co., 10647 Wixom, Sun Valley, Calif., or check Inform-A-Gram No. P11.

"TORQUE WRENCH" MANUAL

Formulas
Applications
Engineering Data
Screw Torque Data
Adapter Problems
General Principles

SENT UPON REQUEST

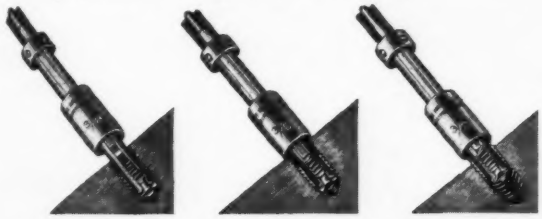
PA STURTEVANT CO
ADDISON QUALITY ILLINOIS

Manufacturers of over 85% of the torque wrenches used in industry

CIRCLE INFORM-A-GRAM KEY NO. 611

A Specialized Tap Extracting Tool *that will stop small cost leaks in Metalworking*

How much labor and production time do you waste removing broken taps? How many expensive parts are damaged or scrapped by makeshift methods? Much of this time, and the parts, can be salvaged with Walton Tap Extractors.



1. The extractor's sturdy, heat treated steel fingers are inserted into the flutes of the broken tap.
2. The extractor is pushed down until it touches the broken tap, and the sleeve placed firmly in contact with the work.
3. With a tap wrench (not shown) applied to the square end of the extractor, the broken tap is simply and easily backed out.

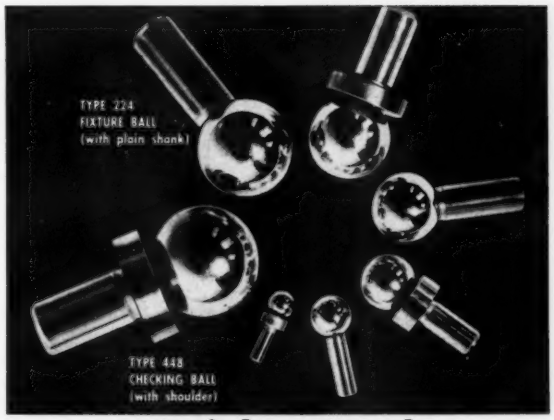
No annealing or drilling required. The broken tap is removed without delay . . . . *and without damaging the threads.* Furnished for machine screw and hand taps, pipe taps, and Helical Coil "STI" taps in all standard flute styles for sizes #4 to 1½". Try them at our expense (free trial) in your shop.

Write for Data *Folder No. 38*

WALTON TOOLS SINCE 1908 HARTFORD, CONN.

THE WALTON CO. HARTFORD 10, CONN.

CIRCLE INFORM-A-GRAM KEY NO. 612



Stainless Steel
TOOLING BALLS

- **Used in** jigs, fixtures and job setups as positive reference points for locating holes and surfaces at compound angles or in two or more planes.
- **Durable.** Made of hardened 440-C stainless steel.
- **Highly accurate.** Ball size is held to ±.0001" for fixture balls; ±.00002" for checking balls.
- **In stock** in 7 ball sizes, ¼" to 1" by ⅛" steps.

WRITE FOR prices and fact-filled BULLETIN B-42.

INDUSTRIAL TECTONICS, INC.
MANUFACTURERS OF PRECISION BALLS AND BEARINGS
BALL DIVISION: 3686 JACKSON RD.
ANN ARBOR 4, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 613

Save Time, Money, Labor
find cracked parts quickly, easily, with
MAGNAFLUX Spotcheck®
DYE PENETRANT INSPECTION

NOW— Fire-Safe MATERIALS at same low prices

HERE'S WHY
Cracks, pores and defects open to the surface can cause rejects or failure in service. In parts or machinery this can mean costly repairs, prolonged downtime, extensive damage, even loss of life! Cracks can be eliminated thru inspection at any stage in manufacture, — or during maintenance overhaul.

HERE'S HOW
Inspect with easy-to-use Spotcheck. Dye penetrant inspection becomes as simple as pushing a button. All materials available in spray can and Fire-Safe— cleaner-dye remover, penetrant, developer. Defects are clearly defined as bright red marks against the white of the developer. Works on any solid material! Bulk materials also available, up to 55 gallon drums.

COMPLETE SK-3 KIT only $36.00
U. S. A. only
F. O. B. our plant
Chicago, Illinois

Everything you need in handy, rugged steel carrying case. 2 spray cans Penetrant, 2 spray cans Developer, 4 spray cans Cleaner-Dye Remover, instruction book, cleaning cloth, wire brush. ORDER FROM YOUR DISTRIBUTOR, OR DIRECT!

MAGNAFLUX CORP., 7339 W. Ainslie Ave., Chicago 31, Ill.
☐ Please send me _____ SK-3 Kits at $36.00 each, F.O.B. Magnaflux plant Chicago.
☐ Send FREE bulletin only. Includes low Spotcheck material prices in bulk.

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____

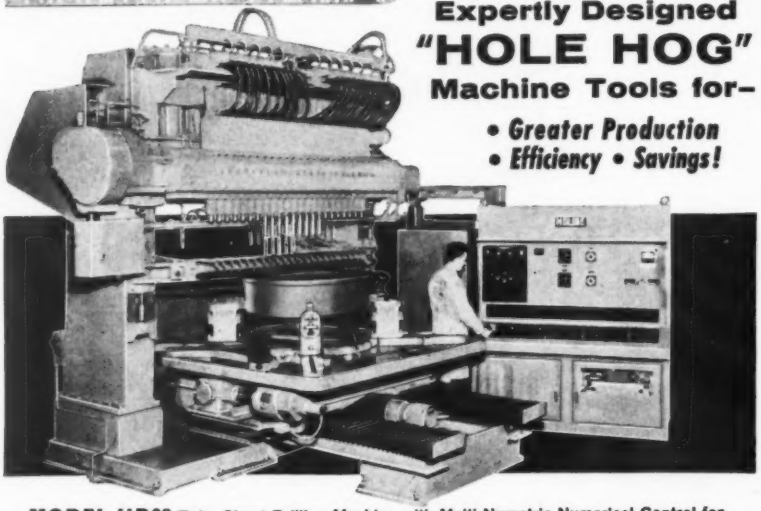
CIRCLE INFORM-A-GRAM KEY NO. 614

MOLINE

MULTI-NUMETRIC NUMERICAL CONTROL (AS APPLIED TO MULTIPLE SPINDLE DRILLING)

Expertly Designed "HOLE HOG" Machine Tools for–

• *Greater Production* • *Efficiency* • *Savings!*



MODEL HD68 Tube Sheet Drilling Machine with Multi-Numetric Numerical Control for positioning of machine table in two directions and for selection of spindles. Information on punched tape permits automatic drilling of a complete hole pattern in a tube sheet without interruption.

60 years of Machine Tool Engineering Experience is at your service for——

115

• Multi-Spindle Boring • Single and Multi-Spindle Honing
• Straight Line Multi-Drilling • Adjustable Spindle Drilling
• Special Multiple Operation Machine Tools

Write for Details

MOLINE TOOL CO. MOLINE, ILL. U.S.A.

MOLINE TOOL COMPANY
100 29th STREET • MOLINE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

CIRCLE INFORM-A-GRAM KEY NO. 621

"On the Button"...

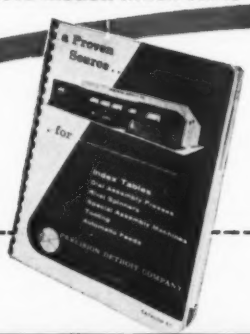
DIAMETERS
18"
24"
30"
36"
42"
48"
54"
60"

Number of stations to suit your requirements

PDC-JIC SERIES "AUTOMATIC"
Geneva Motion Index Table

YOUR CHOICE

- Electric Motor Drive
- Fluid Motor Drive
- Rotary Air Motor Drive



Write **TODAY** for new Catalog 60, for designers and engineers

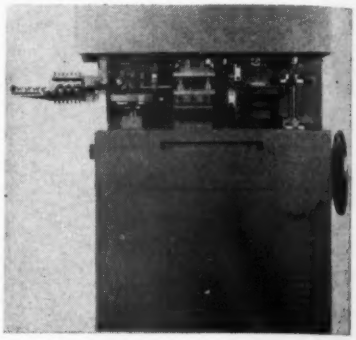
PRECISION DETROIT COMPANY
20100 SHERWOOD • DETROIT 34, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 622

Product News

Speedy Metal-Processing

A new vertical metal processing machine (V-80) is especially designed for high-speed, precision production of small wire and strip components. Verti-Slide subassemblies allow adaptation for welding, tapping, swaging, and thread-rolling. Stock capacity is ¾" maximum strip width, 0.032 maximum strip



thickness, and 1/16" maximum wire dia. Production rates are from 100 to 500 strokes/min with standard rise cams, and 100 to 350 strokes/min with either maximum rise cams, and 100 to 350 strokes/min with either maximum rise cams or feed lengths. The machine is a smaller version of V-82 and V-81 vertical four-slide machines from Torrington Mfg. Co., Torrington, Conn. Inform-A-Gram No. P14.

Every Shop Should Own One

No distortion — even on 1/8" stock!
MODEL "C"

KNURLMASTER Hand Knurler

For small production runs on 1/8" to 1" stock. Exclusive screw design gives perfect knurl pattern. Furnished with 3 hardened straight or diamond pattern knurls of standard ½" dia. Forged steel frame is self-centering. Write for illustrated folder.

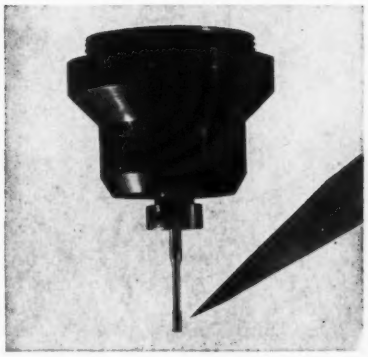
ROCKWIN MANUFACTURING CO.

80A MAGNOLIA AVE., WESTBURY, L.I., N.Y.

CIRCLE INFORM-A-GRAM KEY NO. 623

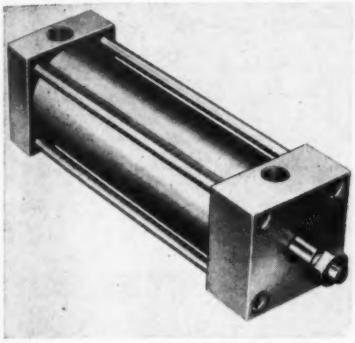
Product News

Speedy Hole Grinding



Vulcanaire 300 grinds soft or hard steels, ceramics, glass, carbide, sapphire and exotic materials with equal facility. It finishes minute holes precisely and economically. With four variable speed precision air motors, Vulcanaire has a speed range from 6000 to 300,000 rpm. The 300 Series grinds 0.020 to 0.090 dia holes. Like the 65,000 Vulcanaire this new, faster instrument can be attached to all types of grinders, profilers, jig borers, vertical and horizontal milling machines, boring mills, lathes and drill presses. Write Vulcan Tool Co., 730 Lorain Ave., Dayton 10, Ohio, or Inform-A-Gram No. P15.

General Purpose Cylinders



Series C, new 200 psi maximum air cylinders, are offered in 1¼, 1¾, 2½, 3⅝ and 4½" bore sizes. Compact design provides three basic mounting positions — side, cap end, or head end. Friction is reduced through an oil impregnated bronze rod bushing that provides constant lubrication. The unit's exclusive Wiperseal serves as rod wiper and pressure adjusted sealing element. One piece non-score piston construction eliminates metal-to-metal contact on cylinder body and stroke ends. For additional information write Hannifin Co., Dept. 164, 501 S. Wolf Rd., Des Plaines, Ill., or check Inform-A-Gram No. P16.

WHY WAIT? IMMEDIATE DELIVERY!
LARGEST STOCK OF
SPECIAL RH & LH Taps-Dies & Thread Plug Gages
Also in Stock:
• RING GAGES • ACME & METRIC TAPS & DIES
• SPECIAL REAMERS
• EX. LONG DRILLS
Write Today for WALL CHART Special Taps Also Made to Your Print Specifications
Quotations on Request
FIELD TOOL SUPPLY CO.
Industrial Cutting Tools
31 S. DESPLAINES ST., CHICAGO 6, ILL.
All Phones: Financial 6-1195
CIRCLE INFORM-A-GRAM KEY NO. 632

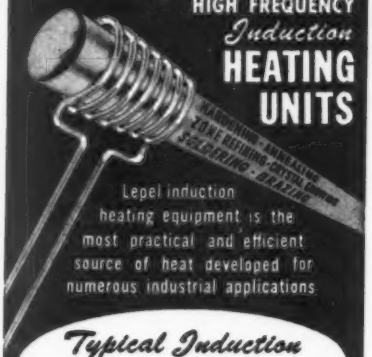
NEW! ONLY ..... $15 ★
Buys This Compact Mist Coolant Unit
TRICO TYPE "J"
*Complete With Magnetic Nozzle Holder As Shown (in U.S.A.)
Especially designed for small precision machinery used for drilling, tapping, sawing, grinding, etc. Up to 500% savings through increased cutting speeds and tool life. Check these quality features and write for complete details.
- compact . . . measures 3" x 5"
- separate air and coolant controls
- convenient mounting stud
- attaches to existing shop airline
- shatter-proof 8 oz. reservoir
- neoprene flexible coolant line
- magnetic nozzle holder positions anywhere
- controlled discharge

Larger Types and Capacities Available
SEND FOR BULLETIN NO. 37
TRICO FUSE MFG. CO.
MILWAUKEE, WIS. U.S.A.
CIRCLE INFORM-A-GRAM KEY NO. 633

High-Output with ROUSSELLE
DOUBLE-CRANK PRESSES
SPEED UP PRODUCTION with these versatile 40-ton presses. Large bed and ram areas make them ideally suited to handle wide rolls or sheets . . . do multiple punching, steel-rule die work and other high output operations. For rapid, shockless starting and stopping, presses can be equipped with electrically controlled "Econo-Air" friction clutch . . . Ask for new catalog.
No. 4B OBI with "Econo-Air" clutch.
Choice of over 30 models and types in 5 to 60-ton sizes
STRAIGHT SIDE — Die space up to 24 in.; bed space up to 6 ft. between uprights.
SERVICE MACHINE COMPANY
Mfrs. of Rousselle Presses
2310 WEST 78TH STREET • CHICAGO 20, ILLINOIS
Rousselle Presses are sold exclusively through Leading Machinery Dealers.
CIRCLE INFORM-A-GRAM KEY NO. 631

LepeL

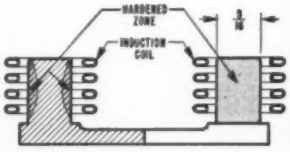
HIGH FREQUENCY *Induction* HEATING UNITS



Lepel induction heating equipment is the most practical and efficient source of heat developed for numerous industrial applications.

Typical Induction Heating Applications

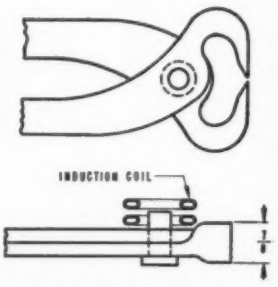
Steel Bosses Selectively Hardened



Bosses on part shown are locally hardened to increase resistance to wear and plastic yielding. Surface hardening by induction provides hardness pattern indicated and hardness of Rc 57/59 for 1040 steel when quenched in water.

Our engineers will process your work samples and return the completed job with full data and recommendations without cost or obligation.

Hot Forming Aids Production Assembly of Nippers



The ends of high-strength steel rivets are selectively heated to 1700° F for hot upsetting. Design of coil permits movement of upsetting tool through the coil.

WRITE FOR NEW LEPEL CATALOG

LepeL HIGH FREQUENCY LABORATORIES, INC.

55th ST. & 37th AVE., WOODSIDE 77, N. Y.

CHICAGO OFFICE: 6246 WEST NORTH AVE.

CIRCLE INFORM-A-GRAM KEY NO. 641

ETALON INGAGE

Measures the exact BORE or blind hole size!

Reading .0001" Size: 3/16" to 4"

Takes accurate measurements of blind holes. No master — measures directly—by .0001". Automatic alignment, rectangular contact points guarantee extreme accuracy even when fully extended. Immediately detects out of round holes; with extensions measures holes up to 30" deep. Hardened contact points exert minimum pressure — will not damage fragile work.

Easy to read, deep graduations on a large diameter thimble. Dull chrome plated. Furnished in English or Metric graduations, individually or in sets.

WRITE FOR CATALOG on complete line of precision measuring instruments: VERNIER CALIPERS, MICROMETERS, DIAL INDICATORS.

ALINA CORPORATION

122 East Second St., Mineola, L. I., N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 642

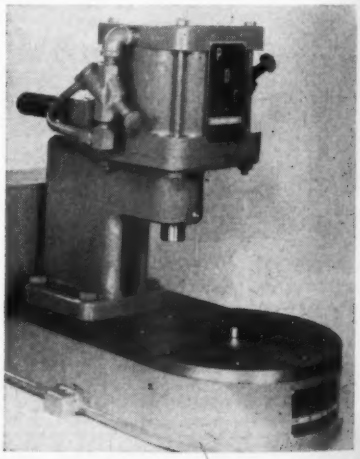
DYKEM STEEL BLUE
Stops Losses
making Dies and Templates
Popular package 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.
Write for sample on company letterhead
THE DYKEM COMPANY
2303L North 11th St. • St. Louis 6, Mo.
With DYKEM Steel Blue
Without DYKEM Steel Blue

CIRCLE INFORM-A-GRAM KEY NO. 643

Product News

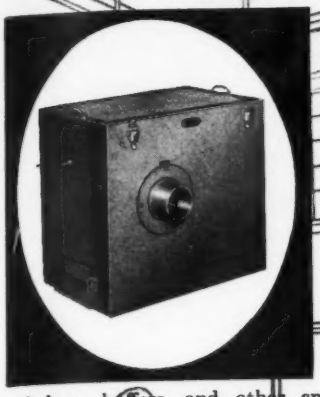
Increased Production

One operator is said to frequently double or triple production on small assembly operations with a new Geneva motion dial assembly press. It has an 11" dia plate with 8 stations, and a 1-ton press head with a 2" stroke and a 3" throat. The unit has an electric variable speed drive with 18 to 36 indexes/min. Precision Detroit Co., 20100 Sherwood, Detroit 34, Mich., plans to offer the machine also with combination press-stake head, spinning head and welding head. Write them, or check Inform-A-Gram No. P17.



DUSTKOP "520"

designed to collect dust from single machines



portable—easily installed

DUSTKOP STOPS DUST

Self-contained Dustkop models like the "520," are practical and effective in collecting dust from single machines. They're designed specifically for service - with surface grinders, tool and cutter grinders, offhand grinders, buffers and other small wheel equipment. These units are also easy to install — are actually portable — and very economical to operate.

Write for illustrated literature
46 models to choose from!

NEW! DUSTKOP AUTO SHAKER shakes filters AUTOMATICALLY

AGET manufacturing company ask for details

1394 E. Church Street, Adrian, Michigan

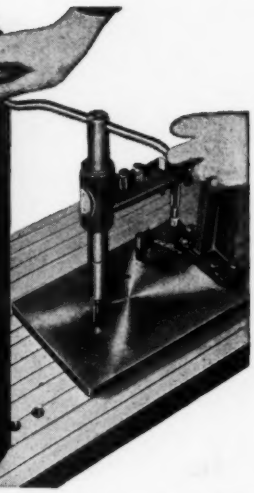
CIRCLE INFORM-A-GRAM KEY NO. 651

Dahlstrom TAP GUIDE

$89.50

F. O. B. Factory

Taps By Hand with Drill Press EASE and ACCURACY



Just spot the hole and turn the handle for fast, easy custom tapping. A ruggedly built Dahlstrom Tap Guide taps straight every time—reduces tap breakage. Saves time lost digging out broken taps. Fastens to bench or carries to job . . . Taps big jobs through base . . . Spindle can tap on lathe or be a tap extension. Comes with 9 adaptors 8-32 to ¾" (taps not furnished) . . . 7½" throat . . . 8" x 11¼" table . . . wt. 32 lbs. *ORDER NOW—SAVE TAPS and TIME!*

Ask for bulletin on the Dahlstrom line of bench tools.

Branch MANUFACTURING COMPANY

16 Olson Drive, North Branch, Minn.

CIRCLE INFORM-A-GRAM KEY NO. 653

Now! MARK NAME PLATES

5 TIMES FASTER ...and SAVE...SAVE...SAVE!

WITH Automark ELECTRIC TAG MARKING TYPEWRITER ®

MODEL EMT-2

A NEW ERA IN NAME PLATE MARKING

Just a touch of the finger delivers up to 2 TONS pressure for deep, legible impressions on metal or plastic tags. Standard electric typewriter keyboard—over 100 characters a minute. A modern marvel!

SEND NOW FOR BULLETIN

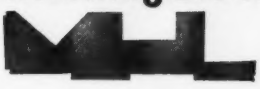
DEFIANCE MACHINE & TOOL COMPANY

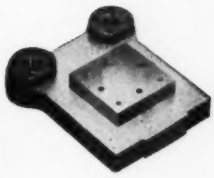
1920 S. VANDEVENTER Dept. TP ST. LOUIS 10, MO.

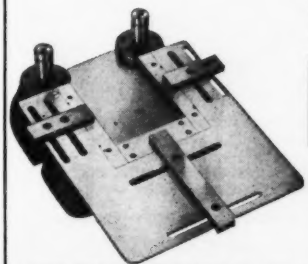
CIRCLE INFORM-A-GRAM KEY NO. 652

Punches and Dies

Notching Die with Gauge Table







Standard stock sizes 4", 5" and 6". Lick those Notching Problems QUICKLY. Gauge table and gauging bars provide accuracy and speed with easy adjustment.

This is another of the many different kinds of punches and dies in stock or made to order for foot, hand or power operation. Precision made from high grade tool steel. Also adaptors and die shoes to convert your press.

29 *years of serving your punch and die requirements.*

What are your punch and die needs? Consult us about your problems. Prompt service on "Specials" made to your order.

SEND FOR FREE CATALOG No. 161 AF, illustrating our standard punches and dies and complete line of modern sheet metal fabricating equipment. Net prices shown.

WARD Machinery Co. 564 West Washington Chicago 6

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ARE YOU PROPERLY GEARED FOR

MINIATURIZATION?

USE THE PERFECT COMBINATION
For **MICRO-DRILLING**

SPHINX
HIGH SPEED STEEL
MICRO-DRILLS

Drills from .0016" to .0591" are stocked in increments of .0004"(.01 mm). From.0610" to .1181" in increments of .0020" (.05 mm). Left hand micro-drills for use on Swiss type automatic screw machines. Short flute center drills. Send for Bulletin "Q" listing complete line of drills or Catalog T listing collets as well as full line of instrument lathes and accessories.

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LEVIN ®

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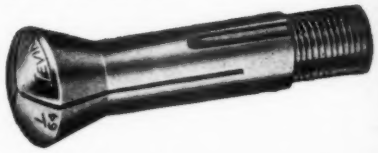

Super precision collets for jewelers type lathes. Ideal for holding micro-drills or other parts where concentricity is important. Available from stock in complete range of sizes from .004" (.1 mm) to 5/16" (8.0 mm).

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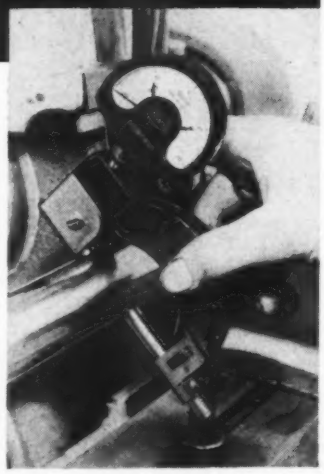
INDICATING SNAP GAGE

with SUPER SENSITIVE GAGING HEAD made by Mahr



ONE SNAP DOES IT

- Makes GO and NO GO gages obsolete.
- Eliminates operator "feel".
- Reads directly to 50 Millionths, 20 Millionths or ½ thousandths with interchangeable gaging heads.
- Available in 5 sizes for work from 0 to 8 inches.

Determine at a glance whether your work is within the tolerance limits. Just set the limits on the INDICATING SNAP GAGE, retract the tungsten carbide measuring faces, with one finger, and let it "SNAP." You can SEE the exact amount of material left to be removed. Ask for folder #125.

GUARANTEED (Mahr) QUALITY
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HANDY ADJUSTABLE

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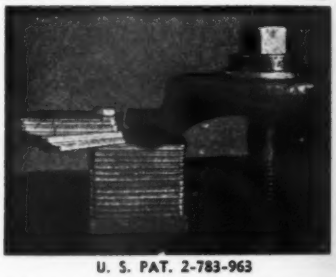

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Use on Drill Presses—Milling Machines—Punch Presses—Surface Grinders—Planers, etc. End lost time looking for right height odds and ends.

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- Give heights from 3/8" to 2 3/8" in 1/8" increments.
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- Cost only $7.50 per pair; $75.00 per 12 pairs, plus transportation costs. Shipping weight 3 lbs. 10 oz per pair.

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City ..... Zone ..... State .....
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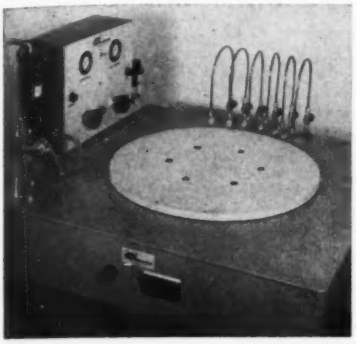
Product News

Fusion Paste Tables

Fusion Engineering, 17921 Roseland Ave., Cleveland 12, Ohio, producers of the Fusion paste method, now make standard rotary and indexing tables to simplify the process. Fusion pasting involves automatic application of paste solder or brazing alloys via



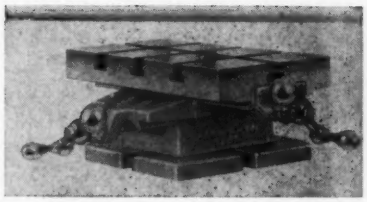
automatic heat with natural gas and air burners. The new indexing and rotary machines now allow automatic handling of parts. The tables come completely mounted and tooled minus customers' fixtures. Write the makers, or circle Inform-A-Gram No. P18.

Sharp Cuts

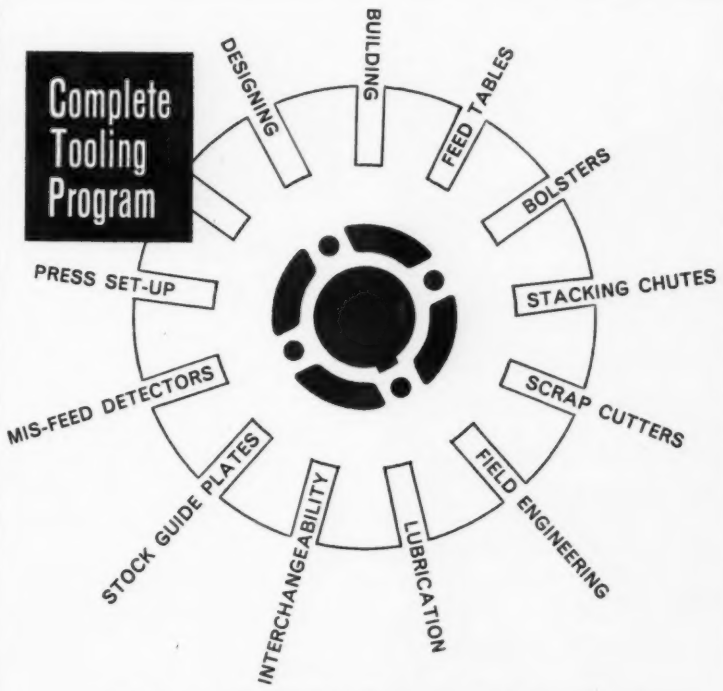
Plunge cutting, slotting, contour cutting, profiling and general purpose end milling on virtually all materials can be performed with new Thriftmite. The new end mills are precision ground with 40° helical flute, and are equipped with 2 or 4 flutes and 3/16" shanks. They are available from stock from the Cutting Tool Div., Brown & Sharpe Mfg. Co., Providence 1, R.I. Write them, or circle Inform-A-Gram No. P19.

Dual Cross Milling Table

A new dual cross milling table is ideal for use on milling machines, grinders, and layout work. It can be furnished with 10 x 6" or 12 x 6" table top surface. Either size has one longitudinal T-slot and three equally spaced cross slots. Easy to read dials are 1¼" dia graduated in thousandths. Balance cranks are removable. The large square base has four mounting lugs and ⅝" keys, and keyways



for machine slot mounting. More information on table #85 is available from Palmgren Steel Products, 8383 S. Chicago Ave., Chicago 17, Ill. Or circle No. P20.



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Oberg Programs a package that includes the designing, engineering and building of a single or series of Carbide Dies—also the auxiliary tooling, if required.

But that's not all! If requested, an Oberg Engineer directs the installation of the Die in the customer's plant . . . *after* it has been production-proved and the operating personnel have been trained in its use and maintenance at the Oberg plant.

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FREEPORT, PA.

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MELTING • SINTERING • WELDING
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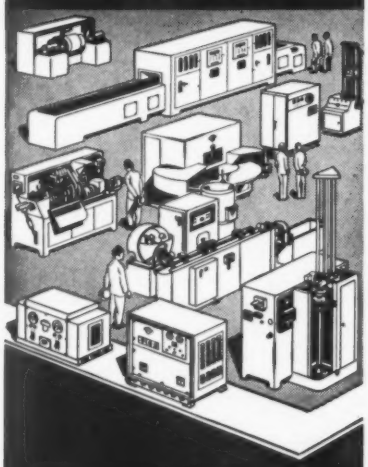

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Subsidiary of HATHAWAY INSTRUMENTS, INC.
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Your hack sawing machines will produce faster cutting-off on all types of work when they are equipped with unbreakable Marvel High-Speed-Edge Hack Saw Blades.

Why? Because these are the blades specifically designed to take the high speeds and heavier feed pressures demanded by today's production schedules.

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WOHLHAUPTER Universal Facing & Boring Heads Feature:

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NEISE MODERN TOOLS

CIRCLE INFORM-A-GRAM KEY NO. 683

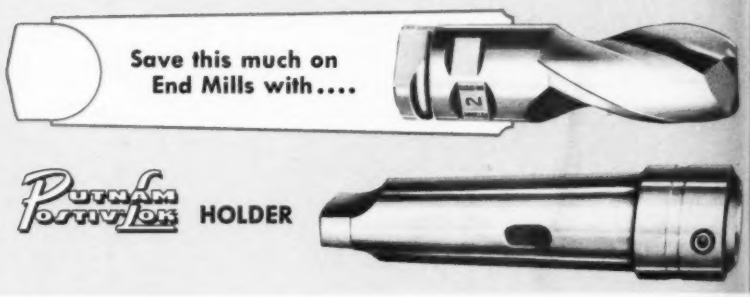
BIG SAVINGS IN
LARGE CUTS

CUT YOUR COSTS OVER 25% ON END MILLS 1½" DIAMETER AND LARGER WITH

The Putnam Postiv-Lok design for large end mills eliminates the need for and expense of long tapered shanks. Instead, the Postiv-Lok concept of end mill tooling puts the heavy shank on a holder that quickly pays for itself through savings realized in the purchase of Postiv-Lok end mills.

Also, the use of Postiv-Lok end mills and holders eliminates the costly breakage that is possible with welded shank end mills. Postiv-Lok end mills are milled from solid steel—there are no welds that might break and separate the shank from the fluted portion. Thus, Postiv-Lok eliminates a cause of costly shut-downs and replacements.

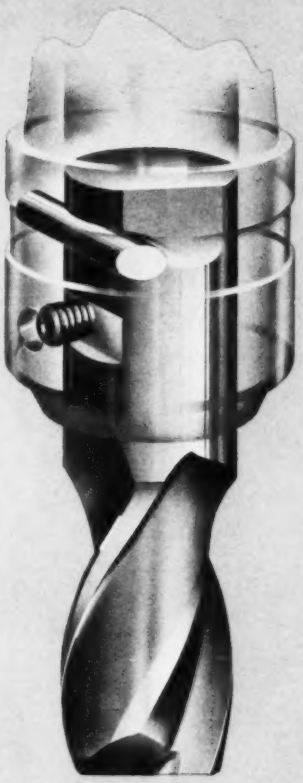
Another cost saving is realized with Postiv-Lok during tooling change-over. Being much lighter, Postiv-Lok end mills are easier to handle than large tapered shank end mills—easier to insert and remove. And, when the next operation requires a different style or size of end mill, or even drilling and reaming, Postiv-Lok adapters permit quick change-over from one tool to another without changing the holder in the spindle.



PUTNAM PRECISION TOOLS

MILLS WITH

PUTNAM POSTIV-LOK



Postiv-Lok is a proven locking mechanism for large end mills. It has saved time and costs for countless users throughout the country. Try it on your most rugged milling application. Postiv-Lok is available from stock on end mills ranging from 1½" to 3" in diameter. Also, it can be furnished in special sizes and designs to your specifications.

Here is how Postiv-Lok assures positive locking of end mills in the holder (see phantom drawing for lock construction). Simply insert the end mill in the holder so the top flat is positioned to pass the locking pin; give the end mill a quarter turn to the right and it is securely locked in the holder. Tightening of holder set screw prevents end mill backlash. The end mill cannot vibrate loose or pull out of the holder. In fact, the locking action is aided by the torque of the end mill in operation.

When put to work on big jobs, the fast, free-cutting action of Postiv-Lok end mills really save time and costs. Alsø, their exceptional durability assures long life even when operated at high speeds and heavy feeds. Try them on your toughest jobs—they will get them done faster and at lower cost.

TOOLS CUT FASTER — LAST LONGER

Over 1800 Standard Types & Sizes of Putnam End Mills

Now you can order standard end mills ranging in diameter from 1/32" to 6" and get off-the-shelf delivery. In the Putnam line of over 1800 standard types and sizes, are many end mills that are considered as "specials" by other manufacturers.

Regardless of your requirements, there probably is a Putnam standard end mill that will exactly meet your needs. Thus, you can obtain quicker delivery, plus all the superior Putnam cutting qualities, and at lower costs than "specials".

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- He has large stocks that are immediately available.
- He is dependable and handles quality products.
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- Being one source for many products, he simplifies your purchasing.
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Product News

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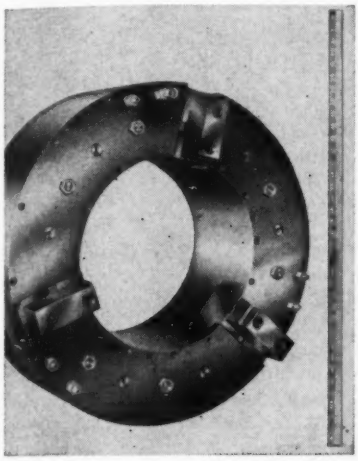

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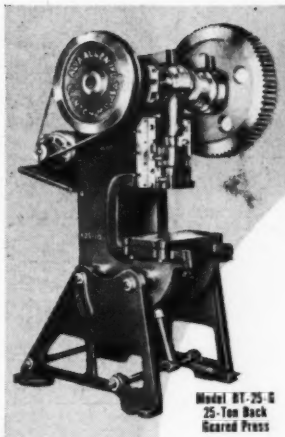

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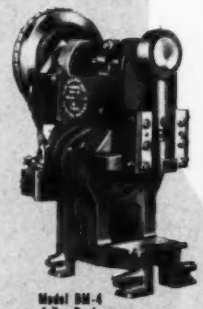
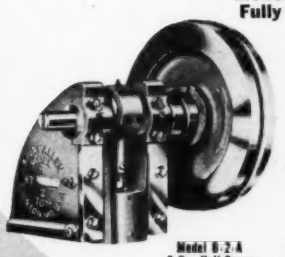
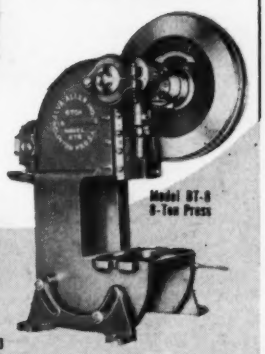
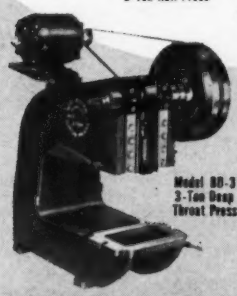
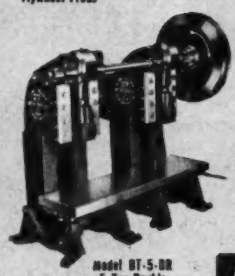

Model BM-4
4-Ton Back Flywheel Press


Model B-2-A
2-Ton Half Press


Model BT-8
8-Ton Press


Model BD-3
3-Ton Deep Throat Press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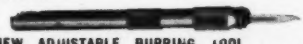

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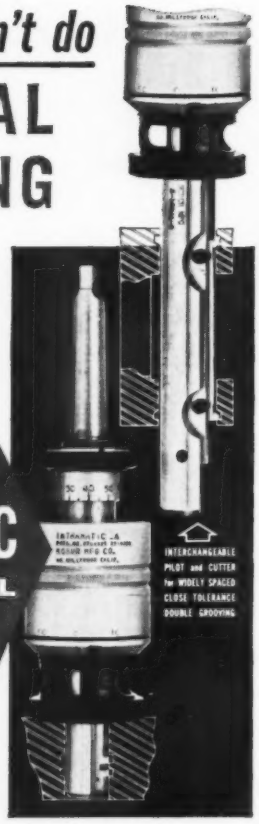

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4. Higher production rates and longer tool life.
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6. Quick interchangeability to various applications.
7. Low-cost flat-form cutters for most applications.

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INTRAMATIC

Flat-form cutter is channelled and cammed from directly within the pilot. Cutting forces are constrained and balanced without compression or torsional deflection of cutter.

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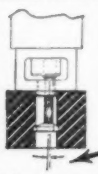

Extended and unsupported cutter is subject to deflection under cutting load. Many-fold disadvantages are evident.

Deflection of cutter from true axis.

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Product News

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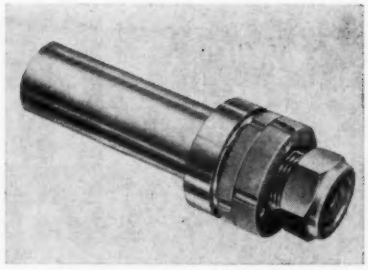
Trav-A-Dial promises continuous indication of carriage, slide or tool position in relation to workpiece within 0.001. The reader attaches to any machine tool with a special spring-loaded mount and fabricated bracket. Guaranteed accuracy of 0.001 in 6" of travel has been maintained after the equivalent of 5 yrs normal use, according to Southwestern Industries, Inc., 5880 Centinela Ave., Los Angeles 45, Calif. Write them for added information, or mark Inform-A-Gram No. P22.

Tool of All Trades

Contour Scriber is billed as the tool of 1001 applications. It marks circles or scrolls from 1 to 25", and follows irregular uneven lines and surfaces. It serves as a handy work bench tool in the machine trade for fitting sheet metal. The sturdy metal instrument is adjustable to 12¾" and is manufactured by Charles Machine Co., P. O. Box 63, Springfield, N.J. Write them, or check Inform-A-Gram No. P23.

It Floats

Model '09 collet-type floating toolholder compensates for both angular and parallel misalignment between tool and spindle. The angular and parallel floats are intended to prevent oversize or bellmouth holes. The holder employs hardened steel collets for fast tool changing. Collets have a collapsing range of 1/32" and are self-releasing for quick-change operation. The holder is available



in five models and accepts collets from ⅛ to 1⅝" dia. Write Erickson Tool Co., 34350 Solon Rd., Solon, Ohio. No. P24.

Ferro-Tic*
" the only machinable carbide "
Draws 50,000 perfect stainless steel cups
Here's proof:
WOODHAVEN METAL STAMPING COMPANY, INC. states:
"Using steel dies to draw 305 stainless steel cups we had to rework the die after every 5,000 pieces. With FERRO-TIC dies we draw 50,000 pieces before even superficial polishing is needed."

FERRO-TIC is the only cemented carbide that is machinable and heat treatable. Fabrication is similar to tool steels; first conventional machining and then quench hardening for ultimate hardness. WOODHAVEN METAL STAMPING, like most **FERRO-TIC** users, make their own dies with existing equipment, thus, insuring quick service to their customers. In addition to much longer press runs, parts from **FERRO-TIC** dies are within closer tolerances and have better appearance. Since only superficial polishing is required to renew these dies, their actual production life is more than a hundred times that of tool steel. **FERRO-TIC** can be used for blanking, deep drawing, heading dies, arbors, core rods, wear parts, etc.

Sintercast

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WRITE FOR ILLUSTRATED BULLETIN P8

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Chromizing Corporation, Hawthorne, Calif.
Propellex Chemical Division, Edwardsville, Ill.
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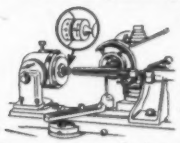
DEPT. TP-8, 712 E. 163rd ST., CLEVELAND 10, OHIO

CIRCLE INFORM-A-GRAM KEY NO. 761

NEW . . . fast, easy CENTER ALIGNMENT for LATHES and GRINDERS

Center being used on grinder

The ENCO Micro-Set® Adjustable Center



Taper reamer being ground

- permits TRUE work alignment from tailstock or headstock on: cylindrical grinders, cutter grinders, gear shavers, lathes and tracer attachments.
- Saves one half the set-up time.
- Ends hit or miss table adjustments to obtain precise alignment.
- An inexperienced operator can get a precise alignment—easily—in seconds.
- Quickly pays for itself in time and scrap savings

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Morse Taper	Brown & Sharpe	Jarno
#2 $49.50	#6, #7 $53.00	#6, #7 $53.00
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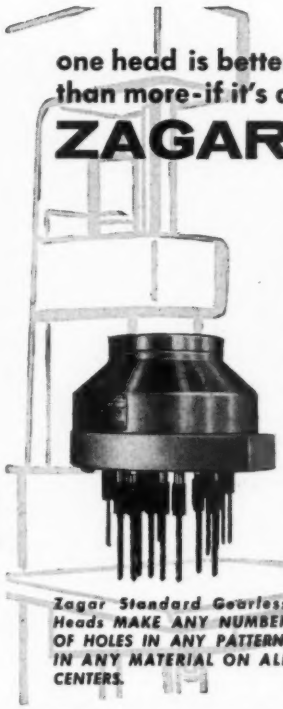
Write for catalog and nearest distributor.

ENCO MANUFACTURING CO. *We also manufacture Precision Lathe Turrets and Tiny-Titan Magnetic Base Holders.* Dept. No. 781, 4520 W. Fullerton Ave., Chicago 39, Ill.

CIRCLE INFORM-A-GRAM KEY NO. 762



one head is better than more-if it's a

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1 to 1000 holes in one pass —as close as twice drill diameter. Costs decrease as spindles are added. And, a variety of hole patterns (or parts) can be produced with *one fixed center head.* Zagar units are adaptable to standard drill presses or are built as a complete installation. Send in your hole problem to Zagar.

Zagar Standard Gearless Heads MAKE ANY NUMBER OF HOLES IN ANY PATTERN, IN ANY MATERIAL ON ALL CENTERS.

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USE MORE SPINDLES TO DO MORE WORK

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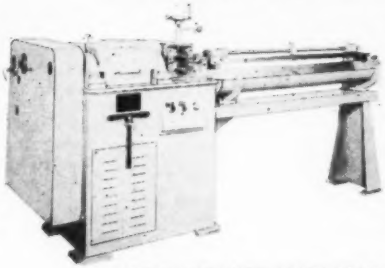
1V18 Shuster Production Booster

Capacity .062" To .125"



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WITH INFINITE VARIABLE SPEED
PRODUCTION 25 TO 150 F.P.M.
12000 CUTS PER HOUR TO 8"

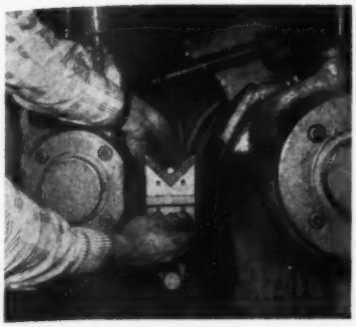
• New electro-mechanical positive release target eliminates jamming • High speed straightening arbor boosts production • Timken bearing equipped feed-roll housing • Larger catch pan • Ideal working height.

METTLER MACHINE TOOL INC.
Boulevard Industrial Park
New Haven, Connecticut

CIRCLE INFORM-A-GRAM KEY NO. 764

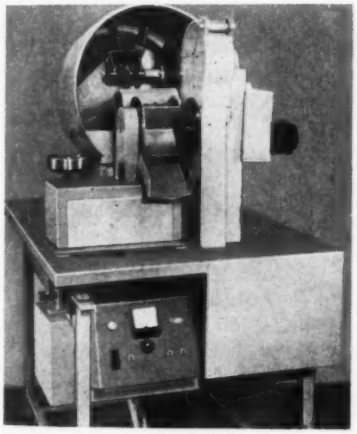
Product News

Outboard Supports



Adjustable V supports, brackets and soft jaws fit all centerless grinders. They let one man do the work of two by making centerless grinding simple. They're usable for through-feed and spot or plunge grinding of all materials and lengths. The easy-to-operate and simple-to-install supports adjust accurately to any size, and are designed to eliminate all taper to the very ends of the workpiece. Livingston Tool & Development Co., P. O. Box 549, Belmont, Calif., is the manufacturer. Write for additional data, or check P25.

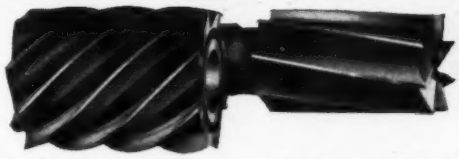
Fast Counter



Atronics parts counter Model 620 handles an unusual variety of parts, sizes and shapes, ranging from paper clips, ball bearing assemblies and fasteners of all types to candy and drug capsules. Weight range is from 0.01 to 2.5 oz, in size up to 2". In about 2 min an attendant can stop one counting operation, empty the machine, reset the simple controls and begin counting out another product. Applications include packaging, prepackaging, bulk shipping, inventory control, incoming inspection and production batching. Specifics from Atronic Products, Inc., West Conshohocken, Pa. Circle No. P26.

Buying low and selling high is one way to make a profit. But buying cutters low is not the way to keep your costs low. A "bargain" cutter may be a cheap cutter. Any short cut in manufacture means you pay for your cutters in another way—short tool life, scrapped parts, or machine downtime. Barber-Colman milling cutters are made one way—from the best, mill-selected tool steels . . . with

BUYING LOW?



painstaking care in heat-treatment and sharpening. They give you lowest total cost per piece. Buy the best, from your Barber-Colman representative.

BARBER COLMAN

BARBER-COLMAN COMPANY 87 Loomis Street, Rockford, Ill.

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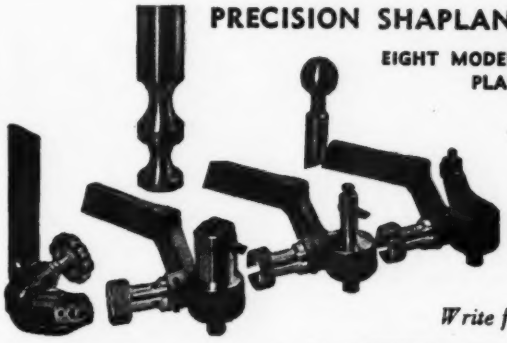
PRECISION SHAPLANE RADIUS TOOLS

EIGHT MODELS FOR LATHES, SHAPERS, PLANERS AND BORING MILLS



Range: 3/8" to 3" for concave radii on lathes. Two sizes for convex radii (Balls up to 2½" dia.) on lathes. Also heavy duty model for radii to 6" on planers, etc.

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Patent Pending

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COOK'S LEAD HAMMER SERVICE

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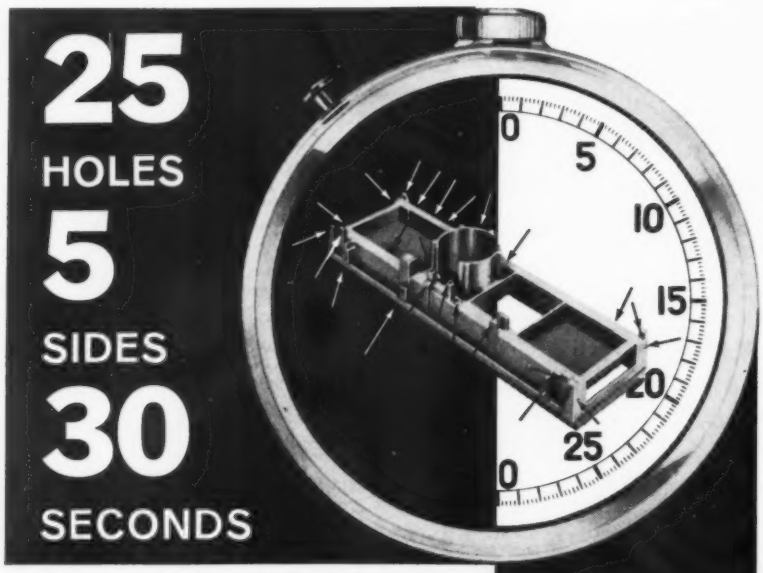
CIRCLE INFORM-A-GRAM KEY NO. 773

The Inform-A-Gram Card which follows page 52 is for your convenience in making inquiries about advertised products and editorial articles.

Product News

Precision Lathe

High precision quality work is credited to a new manufacturing lathe from Rivett Lathe & Grinder, Inc., Brighton 35, Boston, Mass. Model 1020M is extremely flexible. It takes a ¼" cut in rolled steel, or turns within 0.0004" in 12". With a 12½" swing, the spindle takes collets up to 1⅛" capacity. Power longitudinal feeds are from 0 to 16 ipm, and power cross feeds from 0 to 8 ipm. The lathe features a swivel mounted tracer that turns between centers using power longitudinal feed. For work held in face plate, the unit uses power cross feed. Write the makers, or check Inform-A-Gram No. P27.



ON THE WIS-MATIC
5-WAY MACHINE

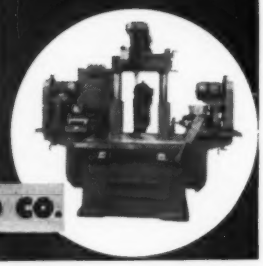
In ONE work-cycle (30 seconds from floor to floor), holes are drilled, countersunk and spot faced to exacting tolerances on 5 sides of a 6-sided, highly irregular work-piece by this versatile, adaptable, 5-Way Drilling and Tapping Machine equipped with Package Tooling and Wisconsin Drill Heads. Here is what it does at the push of a button in this particular application:

- Top Unit drills 5 holes
- Left Unit drills 7 holes
- Back Unit drills 2 holes
- Front Unit drills 2 holes
- Right Unit drills 9 holes

Write for illustrated Bulletin No. 560.

WISCONSIN DRILL HEAD CO.
4975 N. 124th STREET • BUTLER, WIS.

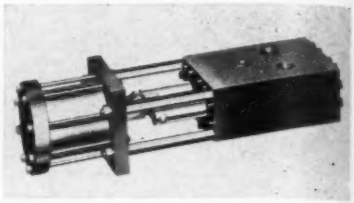
WIS-MATIC can solve your HOLE PROBLEMS just as efficiently, cut your hole processing time just as drastically.



CIRCLE INFORM-A-GRAM KEY NO. 78

Dual Sealed Valves

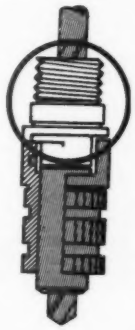
Lever or pilot operated sealing type, 2-way hydraulic control valves from Hunt Valve Co., Salem, Ohio, are capable of holding rated pressure in both directions. They are suitable for pressures up to 5000 psi. Valve U-packers face in toward valve ports



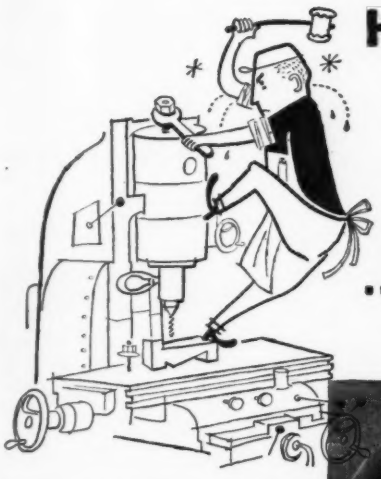
and intensification of pressure results in tighter sealing. High pressure on the outlet side can be intensified for testing, within valve pressure rating limits, without leakage or damage to the packers. The valves are offered in ½, ¾, 1, 1¼, 1½ and 2" sizes in pressure ranges 2000, 3500 and 5000 psi. Write the maker or circle Inform-A-Gram No. P28.

Fast Mounting

The Ace-Keller tip provides a fast, accurate method for fast mounting of portable or stationary air-feed drill motors to metal parts. It is equally adept for mounting tapping, back spotfacing or other self-contained machining units on a jig or fixture. The threaded end of the Ace-Keller



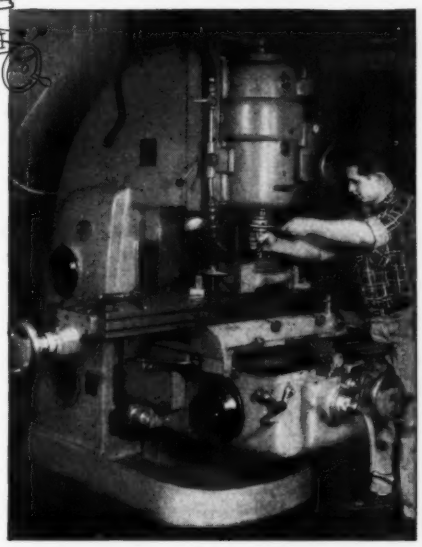
drill bushing tip screws into the nose end of the drilling unit. Locking flanges on the tip fit firmly under the shoulders of the lockscrews or lock strip on the jig. They hold the drilling unit securely in alignment and absorb thrust and torque. Write the Ace Drill Bushing Co., Inc., 5407 Fountain Ave., Los Angeles 29, Calif., or circle Inform-A-Gram No. P29.



HOW MODERN IS *YOUR* METHOD?

...THIS

... or *THIS*



The modern P.D.Q. tooling method completely eliminates the time lost in changing old fashioned type tools. No more "sweating out" loosening and tightening the draw bolt. A 60° turn of the lock nut and you're ready for another tool. P.D.Q. tool changes are only a matter of *seconds* . . . and tools are available in very small, small, medium and large series depending on the application. Write for literature covering all the advantages of modern, cost cutting P.D.Q. (Portage Double Quick) tooling.

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Noblewest ROLL-O-MARK is the world's most versatile general purpose marking machine. It produces sharp, clear, **permanent** indented impressions into metal, wood, plastic and other materials. Model 50P1, shown, has air powered work table and die slide. With Cyclomatic Control will mark up to 1500 pieces per hour. Other models with manual or semi-pneumatic operation. Write for specifications.

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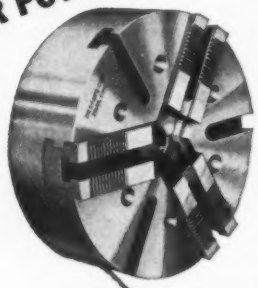
SUPER POWER CHUCKS



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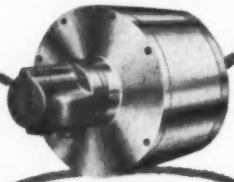

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$39.50 SET OF 3

3 convenient sizes with 3/4" shank and stand used with 5/16" carbide or high speed tool bits. Will machine up to 6" wide surface.
NEW counterbalanced model allows faster speeds and feeds. Made of steel—hardened. Save on expensive end mills and sharpening cost. Better finishes. Write for Bulletin.
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CITY TOOL
DIE & MFG. CO., INC.
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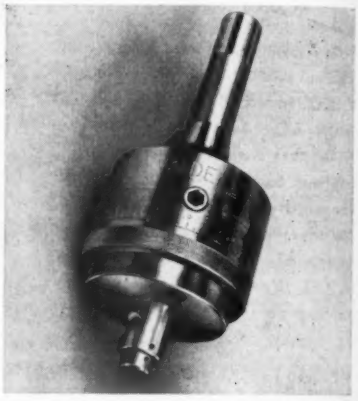
CIRCLE INFORM-A-GRAM KEY NO. 802

Product News

Accuracy in Millionths

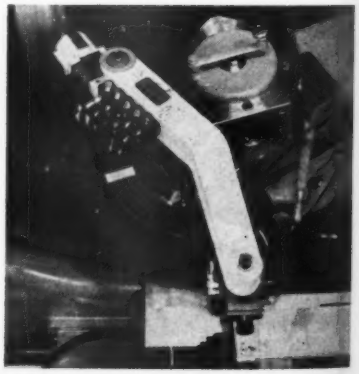
Micro-Magic is credited with repetitive accuracy in millionths and is unimpaired by wear. It's for use on precision boring machines, jig borers, and other machines where quick tool changing, high precision and multiple operation is necessary. One complete unit and two top plates can perform rough bore, finish bore, and counterbore. Accuracy is maintained regardless of tool changes. Wadell Equipment Co., Clark, N.J., suggests that inquiries specify necessary spindle nose dimensions,



diameter, pilot diameter, bolt circle and thread diameter, taper or draw bar. Write them, or circle Inform-A-Gram No. P30.

Easy Mounting Tracer

Mark X tracing attachment enhances the versatility of machine tools for high or low production. It converts a vertical turning and boring machine into a contour turning lathe. It mounts to the ram or turret, or may be installed in place of the side head depending on the machine and job requirements. The attachment needs no machine conversion. The True-Trace Mark X VTL is hydraulically operated and uses the servovalve and cylinder principal and is supplied complete with slide assembly, tracer, template rail and hydraulic power unit, including all lines and fittings. The True-



Trace Corp., 9830 Rush St., El Monte, Calif., or Inform-A-Gram No. P31.

Tool Steel Text Revised

TOOL STEEL SIMPLIFIED, by Frank R. Palmer and George V. Luerssen. Published by The Carpenter Steel Co., Reading, Pa., 595 pages, $2.50.

Latest developments in the fast changing field of tool steels and their application to tools and dies are here described and interpreted. In this third edition, the authors say their fundamental purpose is to "present simplified methods for selecting and heat treating the proper tool steel to make any kind of tool." Messrs. Palmer and Luerssen are respectively chairman of the board, and vice president for metallurgy (retired), for Carpenter Steel Co.

Two new chapters have been added to advise the tool and diemaker on hot work die steels and air hardening steels — two new groups of tool steels that have increased in importance in recent years. A chapter on high speed steels has been rewritten to parallel the broad changeover from tungsten HSS to molybdenum types.

What Makes A Computer Tick?

COMPUTERS AND HOW THEY WORK, by James D. Fahnestock. Published by Ziff-Davis Publishing Co., One Park Ave., New York 16, N.Y., 228 pages, $4.95.

"Computers are designed, built and used by normal everyday men and women," says the preface to this worthwhile book. It continues: "Many people involuntarily suppress their curiosity about this new field with a feeling of hopelessness. This book has been written in an attempt to prove that, taken step by step, a computer is an understandable piece of machinery, far from a mystery."

A scanning of the chapter heads in this "basic training" text will shed more light on its scope. They are: what electronic computers do, computer language, computer arithmetic, digital-computer programming, computer logic circuitry, how men and machines communicate, how computers remember, analog computers, data-acquisition systems, and typical computer systems.

$158 per gage, in 25-gage sets under .3750"

GAGING HOLES TO .0001", .0005", .001"?
Send for helpful FREE "GAGING SHORTCUTS" Booklet

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CLASS "X" - PLUS .000,040" - MINUS .000,000" PRECISION LAPPED
APPROXIMATELY 1 MICROINCH FINISH LENGTH - 2¼", 2½", 3", 3½"

Certification of Accuracy

DELTRONIC CORPORATION unconditionally guarantees each gage herein to be within a size tolerance of plus .000,040", minus .000,00"; surface finish approximately one microInch; both ends concentric to one another. All Master Gages in our plant are calibrated semiannually or oftener, with standards traceable to the National Bureau of Standards, Washington, D. C.

Inspected by: 235

RELIABILITY is assured through continuous checking and surveillance of all Deltronic production and inspection facilities by MetroLonics, an independent Metrology Laboratory, with standards uninterruptedly and directly traceable to the National Bureau of Standards, Washington, D. C. To maintain the most exacting requirements of precision measurement, all gaging standards used in manufacturing of Deltronic gages are calibrated and certified quarterly . . . MetroLonics also completely checks samples of each and every Deltronic production run.

INSPECTION Electronic gaging equipment, accurate to ten millionths or better, is used for all measurement. Roundness is checked on a Talyrond with spindle runout guaranteed to one millionth accuracy. A polar chart showing roundness of a production-run Deltronic gage is reproduced at left. Final lapping, grinding, and inspection performed in Deltonic's plant is in temperature-controlled rooms, maintained within standard 68°, plus or minus one-tenth of 1°.

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MILWAUKEE, WIS.	
Akroline Machines	ME 4-5642
ROCK ISLAND, ILL.	
Ziel Supply Co.	6-5120
ST. LOUIS, MO.	
Helco	PR 6-1787
MEMPHIS, TENN.	
Branch-Merwin	BR 4-6102
KANSAS CITY, MO.	
Haman Machinery	VI 2-3558
CEDAR RAPIDS, IOWA	
Ted Froeberg Co.	2-6547
TULSA, OKLA.	
Wm. L. Riggs Co.	TE 8-1567
DALLAS, TEXAS	
Southwestern Precision	EM 3-1721
DENVER, COLO.	
Di Eugenio Tool	EAst 2-5000
ALBUQUERQUE	
Equipment Sales	CH 7-3781
PHOENIX, ARIZONA	
Di Eugenio Tool	AL 8-8364
SAN FRANCISCO, CAL.	
Brennan-Hamilton	JU 9-2700
LOS ANGELES, CAL.	
Eger Tool & Supply	CU 3-9213
Frey Industrial	LU 8-4281
Marshall Tool	AN 3-6121
Quality Control Co.	HO 9-5385
Don Richetts Co.	CU 3-5642
Paul B. Slater Co.	RA 3-7251
Union Industrial	UP 0-6936
Victor Tool	OR 8-4067
SAN DIEGO, CAL.	
Quality Control Co.	HOllywood 9-5385

Franchises available in some areas:
Deltronic Corporation, Costa Mesa, Calif.

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WEAR-CHECK
Size etched to approx. one-tenth depth. Out-of-size when marking becomes faint - two tenths undersize when marking disappears. . . Reserve marked end for critical inspection.

HANDLE NOT NEEDED
Patented relief in center of each gage enables use without handle, whichever user prefers. Quick, easy, convenient, time-saving.

LOCAL STOCK
Your distributor stocks most-popular sizes. Also over 3,000 gage sizes in tenths, from .0378 to 1", in inventory at factory for same day shipment.

CONCENTRICITY OF ENDS
Both ends absolutely concentric. This, plus extra length, is invaluable for layout, hole spacing measurement.

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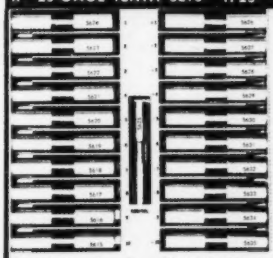
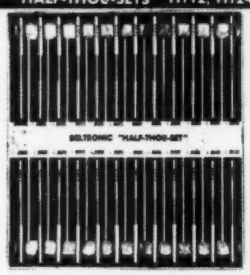
"X" 25-GAGE TENTH SETS TP25



Nominal size, + and — 12 tenth steps. Set #TP25 consists of nominal gage with 24 additional gages. Twelve gages range upward from nominal in .0001" steps each. Twelve gages range downward from nominal in .0001" steps each.

Nom. sizes .039 thru .3750	$39.40
Nom. sizes .3775 thru .6270	$43.80
Nom. sizes 41/64" thru 1"	$52.20

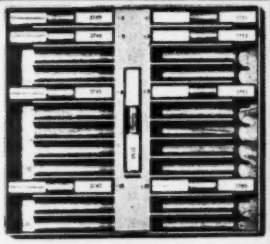
"X" "HALF-THOU-SETS" HT12, HT24



Each set consists of a nominal size gage, plus 11 or 23 gages ranging upward from nominal gage in .0005" steps

Nominal sizes	HT12	HT24
.038" thru . 2 2 8	$23.90	$39.40

"X" 9-GAGE TENTH SETS TP9

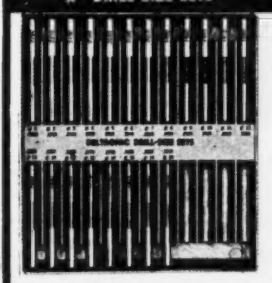


Nominal size, + and — 1, 2, 5, 10 tenths. Set #TP9 consists of nominal gage with eight additional gages. Four gages range upward from nominal .0001", .0002", .0005" .0010". Four down from nominal, .0001", .0002", .0005",.001

Nom. sizes .039 thru .3750	$19.60
Nom. sizes .3775 thru .6270	$22.40
Nom. sizes 41/64" thru 1"	$29.60

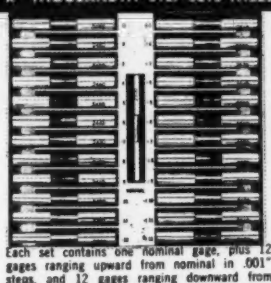
SETTING-STANDARDS

"X" DRILL-SIZE SETS



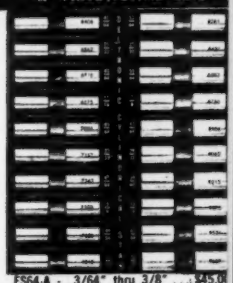
DS61-B - 21 thru 40 ..... $41.00

"X" THOUSANDTH STEP SETS THS25



Each set contains one nominal gage, plus 12 gages ranging upward from nominal in .001" steps, and 12 gages ranging downward from nominal in steps of .001", total of 25 gages $39.40

"X" FRACTIONAL SETS



FS64-A - 3/64" thru 3/8" $45.00
FS64-B - 25/64" thru 5/8" $41.50
FS64-C - 41/64" thru 1" $74.50

CIRCLE INFORM-A-GRAM KEY NO. 81

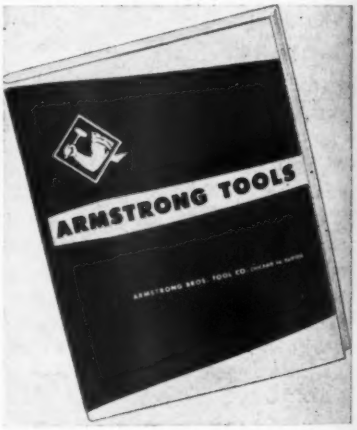
T&P Catalogs & Literature

A newly engineered nose grinding fixture incorporates rocker motion for accurate gun drill sharpening. It's described in an illustrated brochure from Eldorado Tool & Mfg. Corp. Inform-A-Gram No. C1.

Sonite LM-23 high temperature laminating resin and Sonite SC-4 high temperature surface coat epoxy (from Smooth-On Mfg. Co.) are technically outlined in Bulletin 22E and Bulletin 22F respectively. Inform-A-Gram No. C2.

An elementary explanation of time controls and circuitry guides the reader to more complex applications diagrams in a booklet from Haydon Div. of General Time Corp. Check Inform-A-Gram No. C3 for "Basic Timing Instruction Manual."

Meehanite dies and molds are presented in Bulletin 50 from Meehanite Metal Corp. Check Inform-A-Gram No. C4.



There are 330 new items such as toolholders, setup and holddown tools, tool bits, etc. in Catalog 700 from Armstrong Bros. Tool Co. For your copy of this 132-pager circle Inform-A-Gram No. C5.

"Specialized Chemical Processing Compounds for the Metalworking Industry" is the title of a colorful brochure from Turco Products, Inc. Mark Inform-A-Gram No. C6.

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"HELIOS"
DIAL VERNIER CALIPER with built-in DIAL INDICATOR
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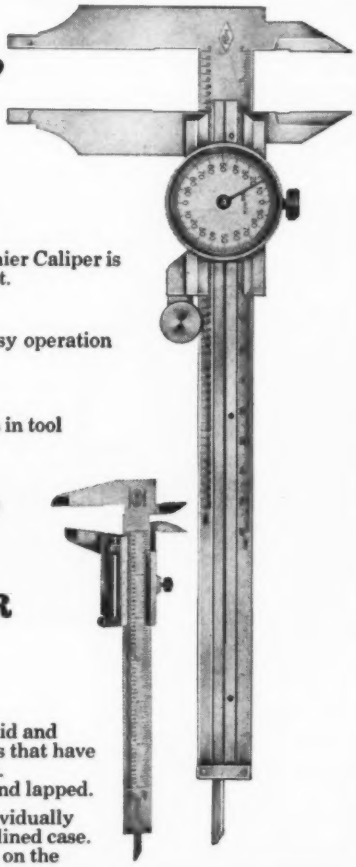

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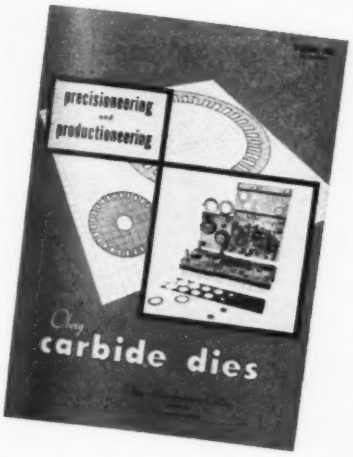
Catalogs . . .



"Precisioneering & Productioneering" is a 52-pager from Oberg Mfg. Co., Inc. For Bulletin 261 circle Inform-A-Gram No. C7.

Catalog 31-D tells of all Northwestern Tools, Inc. items in a condensed manner. Inform-A-Gram No. C8.

Tap Buying is simplified with a 62-page color-keyed tap selector catalog from Besly-Welles Corp. Circle Inform-A-Gram No. C9.

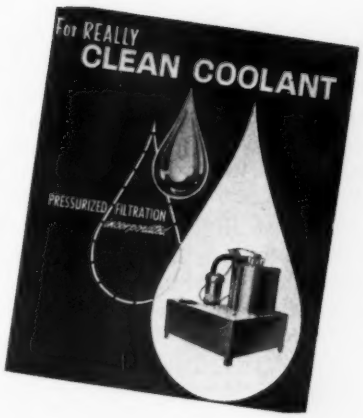
"High Speed Photography" is the title of a bulletin from Wollensak Optical Co. It tells of Fastax high speed cameras, a new engineering analysis tool, for studying actions too fast for the human eye. Inform-A-Gram No. C10.

V9 glass type vitrified bond, used in green silicon carbide abrasive for regular shaped and plate-mounted type wheels, is described in Bulletin ESA-181 from Simonds Abrasive Co. No. C11.

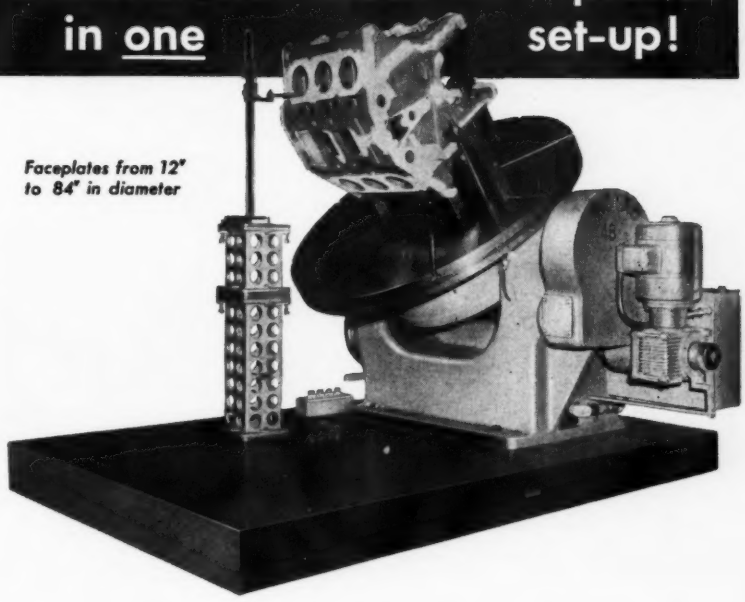
"Really Clean Coolant" is the title of Bulletin 100 from Pressurized Filtration, Inc. Circle Inform-A-Gram No. C12.

Checking Inform-A-Gram No. C13 will bring you a catalog sheet on the largest Havir Press-Rite OBI 125 from Havir Mfg. Co.

Literature on a new family of materials for wet method or visible fluorescent magnetic particle testing is offered by Magnaflux Corp. Circle Inform-A-Gram No. C14.



Dimensional check on 7 planes in one set-up!



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CIRCLE INFORM-A-GRAM KEY NO. 83

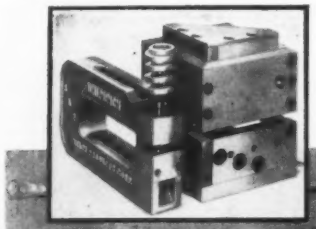
Catalogs . . .

Inform-A-Gram No. C15 will bring you Catalog 21, a 76-pager, from Oil-Dyne, Inc. Some 96 basic models of the miniaturized Oil-Dyne hydraulic pump are fully described and illustrated.

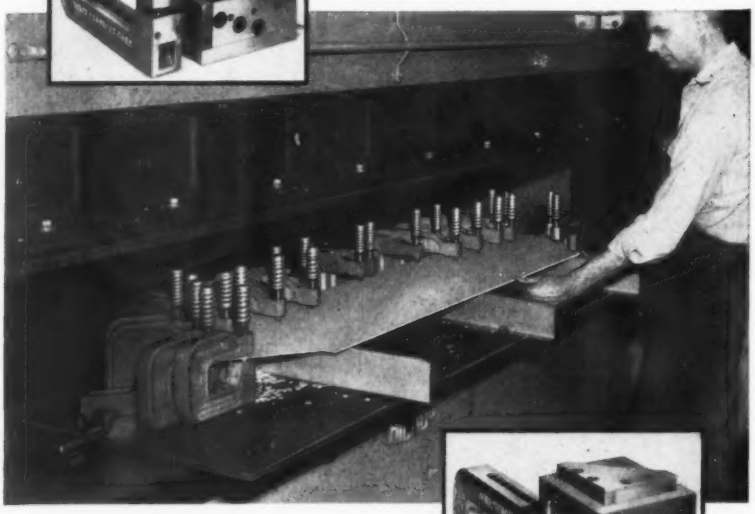
Research metallographic equipment and its outstanding capabilities are detailed in Catalog E-240 from Bausch & Lomb, Inc. C16.

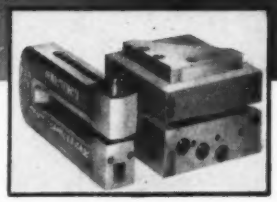
Simonds Double XX and Fibrex reinforced resinoid bonded wheels for weld grinding and general offhand use are extolled in Bulletin ESA-244. Simonds Abrasive Co., Inform-A-Gram No. C17.

Type B Flex Drum, an abrasive cloth wheel that simplifies sanding and polishing complex contoured surfaces, is described in Data Sheet FD-30 from Merit Products. No. C18.



UNIPUNCH SERIES "A" Hole Punching Units punch round and shaped holes up to 3" in diameter in up to ¼" mild steel (Series "AH" for up to ½" thick). Notching Units for corner, edge, vee and special shaped notches may be used in combination setups with hole punching units. Both types of Series "A" Units have popular standard 8⅜" shut height and 3½" die height.





UNIPUNCH SERIES "B" Hole Punching Units punch round and shaped holes up to 3½" in diameter in up to ⅜" thick mild steel or equivalent. Standard or special Series "B" Notching Units may be used in combination setups. Both types of Series "B" Units have popular standard 5½" shut height and 2$^{19}/_{32}$" die height.

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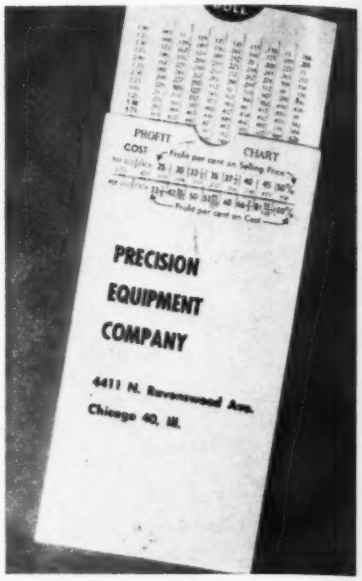

An automatic profit chart makes figuring profits and establishing selling prices easy. It's offered by Precision Equipment Co. on Inform-A-Gram No. C19.

All models of Zagar collet fixtures and collets are described in a colorful and comprehensive manner in a brochure from Zagar, Inc. Inform-A-Gram No. C20.

Full-Floating toolholders and flanged adjustable holders made by Erickson Tool Co. are outlined in a catalog sheet from that company. Inform-A-Gram No. C21.

Sterling Electric Motor's "lube-free" integral and fractional horsepower variable speed drivers are outlined in a 112-page catalog from the company. Inform-A-Gram No. C22.

Catalogs . . .

Moore Special Tool Co., Inc. offers a "Package of Precision" brochure. It tells how to solve problems in locating, boring, grinding and measuring holes to extremely close accuracies. Inform-A-Gram No. C23.

The Or-bit tool bit series is outlined in Bulletin OR-61 from Morse Twist Drill & Machine Co. Circle Inform-A-Gram No. C24.

Rotary files and tools available from Grobet File Co. of America, Inc. are outlined in a catalog. Inform-A-Gram No. C25.

Six models of radio frequency heating units that convert power-line energy to high-frequency electrical energy for induction heating of metals are described in a series of bulletins from Lindberg Engineering Co. Circle Inform-A-Gram No. C26 for Bulletins 1515 through 1520.

Type "M" Mult-Au-Matic, built by Bullard Co., is extolled in a catalog from the company. Circle Inform-A-Gram No. C27.

An 8-page technical paper summarizes results of a 2 yr investigation into the cause of erratic performance and premature failures of precisely engineered metal wear parts. The Electrolizing Co., Div. of Advance Industries, Inc. offers the report free on Inform-A-Gram No. C28.

Catalog MF-100A from May-Fran Mfg. Co. tells of the company's line of hinged steel belt conveyors. Included is a range of convex and concave curved sections, straight sections, take-up end and drive end sections. Inform-A-Gram No. C29.

A technical data sheet on Beacon K-65 with Quenzine Quick Quench Oil is offered by Aldridge Industrial Oils, Inc. Inform-A-Gram No. C30.

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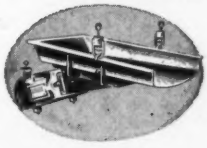
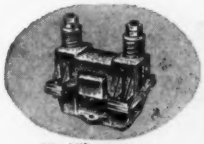

Vibratory Feeders

Battery Chargers


Bin Vibrators

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Number after colon refers to page number.

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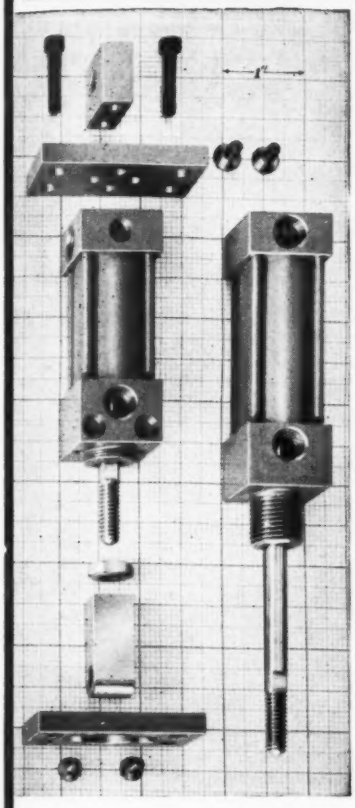

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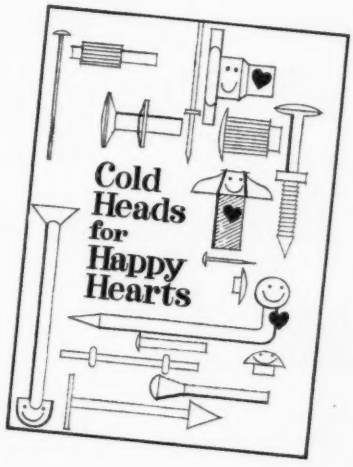

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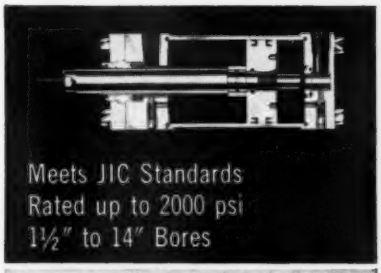

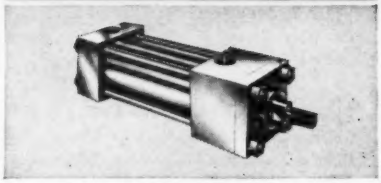

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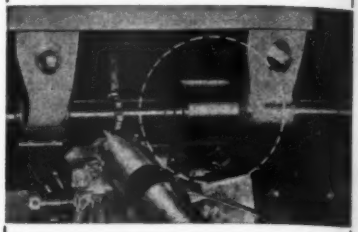

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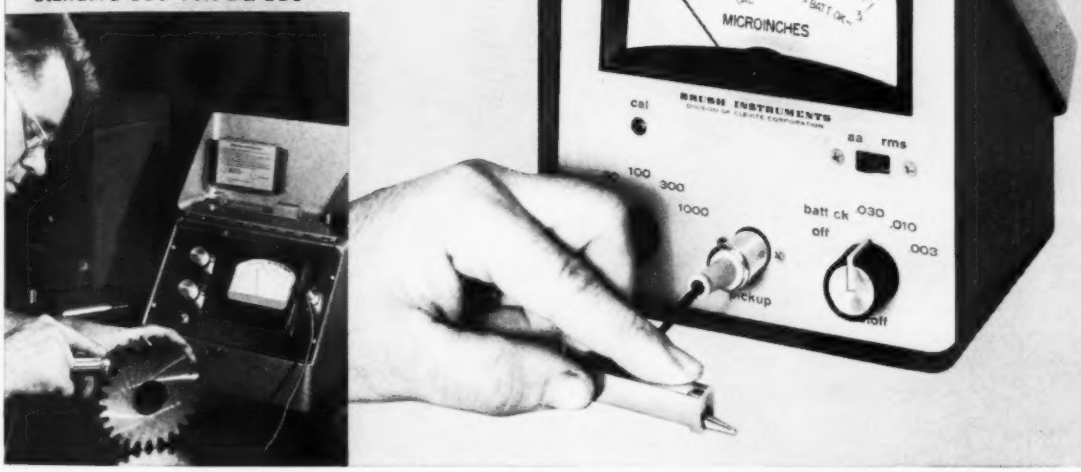

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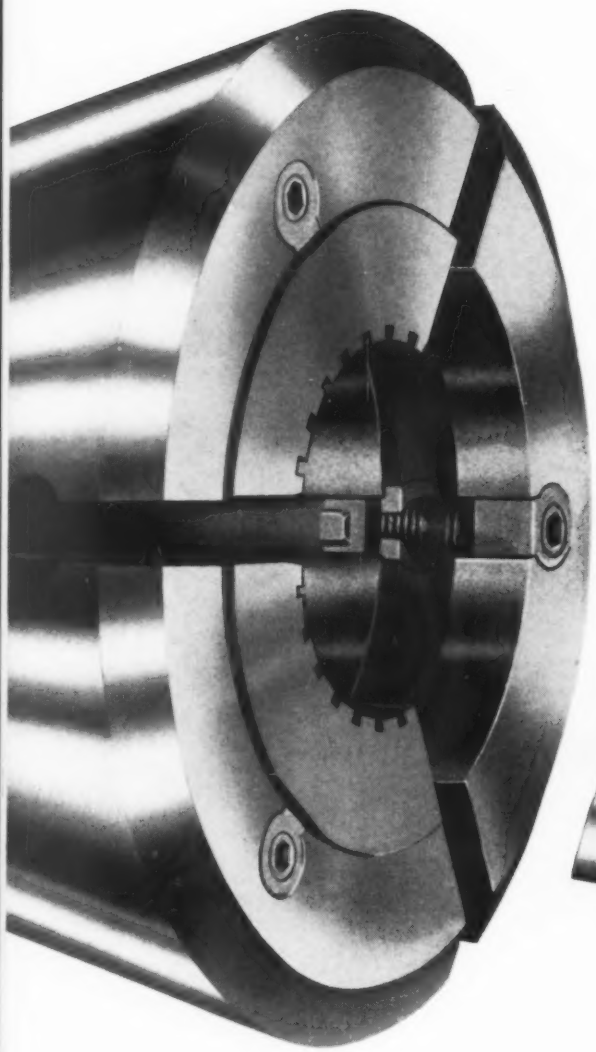

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